Vol.8 No. 3

Bulletin
of the
Chicago Academy of Sciences

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Observations on *Batrisodes* (Coleoptera: Pselaphidae), with Particular Reference to the American Species East of the Rocky Mountains

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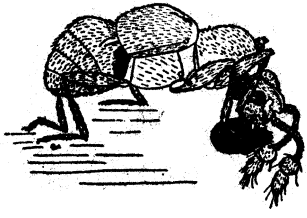

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The Chicago Academy of Sciences
Lincoln Park - 2001 N. Clark Street
Chicago 14, Illinois, U.S.A.

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Publication of the *Bulletin* was resumed in 1934 with volume 5 in the present format. It is now regarded as an outlet for short to moderate-sized original papers on natural history, in its broad sense, by members of the museum staff, members of the Academy, and for papers by other authors which are based in considerable part upon the collections of the Academy. It is edited by the Director of the Museum with the assistance of a committee from the Board of Scientific Governors. The separate numbers are issued at irregular intervals and distributed to libraries and scientific organizations, and to specialists with whom the Academy maintains exchanges. A reserve is set aside for future need as exchanges and the remainder of the edition offered for sale at a nominal price. When a sufficient number of pages have been printed to form a volume of convenient size, a title page, table of contents, and index are supplied to libraries and institutions which receive the entire series.

Howard K. Gloyd, Director of the Museum

Vol. 8, No. 3 **December 30, 1947**

Bulletin of the Chicago Academy of Sciences

Observations on *Batrisodes* (Coleoptera: Pselaphidae) with Particular Reference to the American Species East of the Rocky Mountains [1]

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CONTENTS

[1] This study has been facilitated by a grant from the Graduate School of Northwestern University to partially defray *ex*penses involved in field collecting, in travel to study type specimens and collections, and expense incurred in preparing illustrations.

INTRODUCTION

The present paper is the result of a number of years of intermittent study upon species of *Batrisodes* that inhabit North America east of the Rocky Mountains. As such it is another increment in the gathering of materials for a general treatment of the pselaphid beetles of the Western Hemisphere, and consequently articulates with other incomplete studies by the author on the rich pselaphid fauna of the Neotropical Region, cited in the bibliography.

The genus is unknown from the neotropics (Park, 1942) , but in America north of Mexico is an abundant, common, and important element of the pselaphid fauna. Although the species of *Batrisodes* comprise about one-seventh of the known North American species of Pselaphidae, and although Thomas Say, John L. LeConte, Emil Brendel, and Thomas L. Casey had described the great majority of the known species by the close of the last century, the genus is poorly known, either as a taxonomic or a zoögeographic unit.

The urgent need of a revision was noted by Bowman (1934, p. 57) . Even today no satisfactory key to the females of the genus can be given. It was felt that the eastern species populations could be examined separately in this paper and a similar treatment of the western populations reserved for the accumulation of more data.

TAXONOMIC MORPHOLOGY OF THE GENUS

Some general remarks on the external anatomy of the species in the area under study are necessary to a proper evaluation of taxonomic characters, and to avoid needless repetition of detail in the diagnoses that follow.

In general, the species are elongate-cylindrical, reddish brown to black, with usually polished and conspicuously pubescent integuments. They range in size from about 2.7 mm. long for large specimens of *ionae* to about 1.4 mm. long for small specimens of *riparius.*

The large head is generally about as wide as long, and is usually longer than deep and often wider than the pronotum. The head may be elongate *(ionae)* , but is more frequently transverse.

The lateral view of the head is valuable for an understanding of the several taxonomic regions and sclerites (Pl. I, 1, 2, 3) . Starting at the posterior end, that portion of the head capsule that articulates with the prothorax is the *cervicum.* The cervicum usually is narrowed rapidly to a relatively slender neck that is separated from the head proper by the transverse *cervical sulcus.* Anteriad of this sulcus the head is usually rather abruptly arcuate to form the *occiput,* and in some species *(ionae),* the occiput is strongly tumid. The occiput is continuous anteriorly with the large *vertex.* This area extends from occiput, over the dorsal surface,

to the *antennal incisures,* and transversely from the dorsal border of one eye to the other. The antennal incisures are usually present as a notch or pubescent fovea just above and behind each antennal articulation. These incisures may be conspicuous *(globosus, frontalis),* slender sutures *(foveicornis),* or nearly closed (*lineaticollis*). The occiput-vertex is a useful area in the taxonomy of the genus. It may be densely pubescent to subglabrous, subimpunctate to coarsely punctate, or scabrous *(scabriceps).* Frequently the occiput, or vertex, or both are medianly, longitudinally carinate. This *median vertexal carina* may be absent *(sinuatifrons),* but is usually present, and may be highly developed, approaching a crest *(globosus).* It varies in length between the species, and to a certain extent its length and strength vary within the species population. It may extend from the center of the vertex, on a line with the antennal incisures, posteriorly over the occiput and well on the cervicum, or it may be a very short carina on the occiput.

The sides of the head, above each eye, are often evenly rounded into the dorsal surface of the head, but these margins may be quite sharp, or may bear a right and left *lateral vertexal carina.* These lateral vertexal carinae are especially well shown in *globosus.* Very seldom the vertex bears a small median indentation *(ionae).* All species bear a pair of *vertexal foveae.* These are pits on the vertex, one on each side, between the lateral vertexal carina and the median carina, usually on a line through the eyes. They may be very small *(ionae)* to large *(denticollis);* pubescent *(denticollis, schmitti, nigricans, striatus),* although a majority of species have the foveae nude *(globosus).* These foveae vary among the species in size, depth, pubescent or nude, distance apart, and position along the anteroposterior cephalic axis. Usually they are more or less connected superficially by an arcuate *circumambient sulcus* that extends from one fovea to another, as a broad, apically directed arc over the anterior half of the. vertex. This sulcus is well ,developed in *globosus, furcatus* and *frontalis,* for example, but is much more often partially developed *(uncicornis),* and may be almost absent, and quite difficult to discern.

As a rule the occiput-vertex bears a lateral vertexal carina each side, and a median carina. In a few species, for example *cavicrus, armiger.,* and *monstrosus,* the occiput bears, in addition to the median carina, a right and a left *oblique carina.* In such cases, these three carinae converge apically on the vertex.

Anterior to the top of the head, composed of occiput and vertex, the *face* of *Batrisodes* is composed of two sclerites, the *frons* or *front,* and the *clypeus.* This is a highly complex area and is important in taxonomy. It is frequently the best place to search for. differences between species, as well as secondary sex characteristics.

In general terms, the front extends anteriorly, and often abruptly in a declivous plane between the antennal articulations, from the antennal incisures anteroventrally to the clypeus. Laterally the front embraces the *antennal cavities,* and extends posteriorly to the apical boundary of the eye.

The clypeus is usually continuous with the front dorsally, throughout its length, but ventrally is limited by the *clypeolabral suture.*

For general taxonomic purposes the topography of the front and clypeus may be considered together, as the face. All females have the face relatively simply formed, consisting of a long, declivous slope from the interantennal line to the clypeolabral suture, and in this sex the interspecies differences of the face affect such things as the degree of facial declivity, punctation, pubescence, and amount of narrowing of the face between the antennal cavities.

It is far otherwise in the males. The face may be relatively simple, in which case it is not separable from that region in the female of the same species, or the face may be excessively modified by deep excavations, spines, carinae, teeth, and peculiar pubescence. Such modifications may be used to separate species, as well as sexes.

In the present paper, the face is interpreted differently from previous American keys, in an attempt to avoid confusion in the minds of students who wish to discriminate the species yet do not have reliably named check-collections at hand. Previous keys often divided the species on whether the front was excavated between the antennae, or was not excavated. This sound practice lost its effectiveness when the amount of facial declivity was interpreted also as facial excavation, in addition to obvious, transverse excavation between the antennae.

For present purposes, therefore, we may consider the face as being transversely excavated between the antennae when a continuous transverse depression can be demonstrated from one antennal cavity to the other. Using this criterion, the males of eastern species would appear to separate into three groups: (1) deeply excavated, (2) slightly impressed, and (3) not excavated.

The first group is always easily discriminated. The front is deeply, transversely cleft between the antennal cavities, and far below the antennal articulations to the head capsule. This transverse cleft may be high or low, long to short, pubescent to nude, simple to armed. As a rule, when there is such a cleft, the clypeus is medianly elongated into a conspicuous spine, or the clypeus may be medianly elevated into a conspicuous spine, carina, or tubercle. Such a deeply excavated condition is illustrated (P1. I, 1), and is exemplified by *globosus, frontalis, beyeri, scabriceps,* and *furcatus,* among others.

The second group is less easily recognized, unless the head is examined from a strictly lateral view. From a dorsal view, a slight transverse

impression between the antennal cavities may be overlooked, but in lateral view any entire transverse impression can be seen, and its indenting of the facial line observed in profile. This condition is illustrated (Pl. I, 2), and is exemplified by *foveicornis, cavicornis,* and *antennatus,* among others.

The third group lacks any entire, transverse impression between the antennal cavities. The facial declivity may be abrupt or gently declivous, the width of the declivity may be more or less uniform to the clypeal margin, or strongly narrowed between the antennal cavities, and may be densely punctate, scabrous, or almost impunctate, densely setose to sub-glabrous, medianly or bilaterally impressed in the dorsoventral axis. This condition is illustrated (Pl. I, 3), and is exemplified by *lineaticollis, fossicauda, declivis, schaumi, ionae,* and *monstrosus,* among others.

Ventrally from the clypeus, the *labrum* may be nearly vertical and relatively short *(globosus)* to relatively elongate and oblique to the dorsoventral axis *(lineaticollis).*

The *mandibles* are strong and well-developed in the genus. These structures, and the relatively simple *maxillary palpi* have not been used in the taxonomy of the genus, but have been discussed in general terms by Ganglbauer (1895), Raffray (1908), Reiner (1909) and Park (1942).

Laterally, the head capsule consists of vertex, front, clypeus and gena. The *compound eye* of each side is the meeting place for these four, more or less continuous, areas or sclerites. The eye is usually large, deeper than *long,* subconical in profile, subovate to subreniform from a direct lateral view, vertical to slightly oblique. It is often slightly hirsute, the setae arising between the facets, and usually becoming more dense posteriorly, where they merge with the extensive, and characteristic *genal beard.* The eye usually is relatively large, prominent and contains from forty to sixty facets that appear circular at most magnifications, the hexagonal character not being demonstrated without specially prepared microscope slides. Rarely, the eye is rudimentary. For example, the eye in *monstrosus* shows a sexual differentiation: the males have large eyes of between forty-eight and fifty-two facets, whereas the females have eyes only a fourth as large containing about twelve facets.

The antennal cavities are large, and variously formed among the species, as their peripheries are modified by consequence of the excavation of the face. Hence they tend to be circular where the face is not transversely indented or excavated, but may be confluent with each other, where the face is transversely modified. At the extreme dorsal rim of the antennal cavity is the articular surface of the first antennal segment. This may not be seen unless an antenna is removed. This articular surface appears extremely elongate oval from a lateral view, but is in *reality* circular, since the first antennal segment articulates dorsally to the head.

This articulation is an important pselaphid characteristic, as noted many years ago by Casey, Raffray and others. Where the antennal incisure is clearly defined, it may be seen just behind and above this articular area.

A number of carinae are usually present on the lateral surface of the head, and these serve to divide the surface into three taxonomic areas: (1) the supraocular, (2) preocular, and (3) subocular areas. The supraocular field is bounded dorsally by the lateral vertexal carina, anteriorly by the antennal incisure, and ventrally it may be clearly set off by a *supraocular carina* (Pl. I, 1), but this carina may be absent (Pl. I, 2, 3). The preocular field is bounded dorsally by the supraocular carina, when present, anteriorly by the usually sharply defined posterior limit of the antennal cavity, and ventrally by the long *clypeogenal carina.* The subocular field is comprised of the gena, and lies behind the eye, and below the clypeogenal carina. As previously noted, the eye is at the center of these three areas, and frequently the several carinae unite to form a *circumocular carina.*

The characteristic genal beard of B*atrisodes* has been noted. This continues over much of the ventral surface of the head. This surface is broad and relatively unmodified. Characteristically for the family, the gula is absent, the right and left genae meeting medianly in the *gular suture,* or this latter is vestigial to give a smooth genal surface. At the posterior margin of the genocervical constriction, a single *gular fovea,* or a pair of gular foveae may be present.

The chief appendages of the head utilized in the taxonomy of the genus are the *antennae.* These organs are composed of eleven segments, or *antennomeres.* They are labile structures in the eastern species of the genus, and exhibit many excellent structural abnormalities as between the species.

The females in general have simple, unmodified antennae, the segments being uniform elongate cylindrical to subquadrate. A signal exception is found in the females of *schaumi,* where the ventral face of the tenth antennomere is slightly flattened, and the seventh antennomere has the external apical angle produced in a triangular, dentoid, setose process similar to, but not as pronounced as in the males of the same species.

Before discussing antennal modification in the male sex, a few words must be written concerning the terms applied to the segments in the key, and diagnoses. The antennae are always described as though they were extended in a straight line in front of the head, and parallel to the long axis of the body. In such a position, each segment has an apex, base, dorsal face, ventral face, lateral or external face and a mesial or internal face.

The antennomeres that show abnormal modification are the first, third, seventh, ninth, tenth, and eleventh.

The first antennomere may have the ventral face inflated, with the inflated portion flattened and densely, minutely setose (Pl. II, 12) as *in schmitti;* it may have the ventral face produced into a flat, rounded lobe (P1 II, 10) as in *denticollis,* or produced into a long, acute, triangular spine (P1 II, 11) as in *nigricans;* it may bear a large oval, granulated concavity on its mesial face, as in *tridens,* or the mesial face may be divided lengthwise into a dorsal, flattened, smooth area and a ventral, flattened granulated area, as in *clypeonotus.*

The third antennomere may have the mesial face tumid to almost semicircular, while the lateral face is straight, as in *nigricans* (Pl. II, 11; Pl. VII, 5).

The seventh antennomere has the external apical angle strongly produced as a conical spine, at right angles to the long axis (Pl. II, 8) in *schaumi.*

The ninth antennomere may be from three to four times as wide as long, with the mesial face produced into a wide, thin, setigerous plate (Pl. II, 2) , as in *riparius;* or the external apical angle may be produced in a long acute spine (Pl. II, 9) , as in *antennatus.*

The tenth antennomere is often modified. It is frequently large, spherical to irregularly and transversely ovate, and in some species *(globosus* and several others) is distinctly wider than the last segment. The genus may be divided into two groups on the structure of the tenth segment. A great many species have the ventral face excavated, foveate, or both, whereas a number have the ventral face simply convex. In certain instances the fovea is nude *(globosus),* but it is usually pubescent. The fovea may be minute (Pl. II, 4), not more than a tenth of the length of the ventral face, or it may be a tremendous cavity, occupying four-fifths of the length of the ventral face (Pl. II, 3) as in *cavicornis.* The fovea may be perforate (Pl. II, 4), or constructed in several steps (Pl. II, 3); it may occupy any place on the ventral face, but is usually more basal than otherwise, and may lie within an excavation. Where the fovea is minute, and difficult to discern save with strong illumination and high magnification, it has been unnoted in certain instances by earlier writers, and the lack of information on this point has produced errors in later keys to the species. The ventral face may be flattened (Pl. II, 9), as in *antennatus,* or the segment may have the mesial face produced into an excavated, spinoid cone (Pl. II, 1), as in *uncicornis.*

Frequently the fovea is full of an alcohol-insoluble, white, friable secretion on pinned specimens. This may suggest a sensory function for the fovea of the tenth antennomere, similar to the pearly secretion of the palpal groove of certain neotropical hamotine pselaphids (Park, 1942).

The distal or eleventh antennomere is variously modified, but in other species is simply elongate, convex, uniformly pubescent, with a truncate

base and tapering apex. Some species (Pl. II, 5, 6) have the ventral face simply flattened over the basal half to two-thirds, as in *foveicornis,* or the ventral face may be flattened and bear a transversely oval concavity (Pl. II, 9), as in *antennatus,* or the ventral face may be deeply excavated or concave over most of its surface(Pl. II, 3), as in *cavicornis.* Another series of modifications affects the basal margin of the segment. In this development, the basal areas of the ventral face are produced into a spine, or a tooth. These spines vary in length and degree of obliquity within a given species population, but within this range of variation are species specific. *Batrisodes nigricans* has the basal bead of the ventral face produced into a just barely discernible denticle; *ionae* has a spinoid, inconspicuous, longitudinal ridge on the basal margin of the ventral face; in *schaumi* the spine is conspicuous, and slightly arcuate apically from the basal margin of the ventral face, whereas the basal spine is directed posteroventrally (Pl. II, 1, 2) in *riparius* and *uncicornis.*

In certain cases, the basal portion of the ventral face of the eleventh antennal segment apparently secretes a material similar to that of the foveal secretion of the tenth segment in color, consistency, and reaction to alcohol This is all the more unusual as there is no foveal orifice, and the secretion must be formed from minute pores in the integument. Such a secretion is often noted in pinned specimens of *furcatus,* there being a large white conical mass of dried, or precipitated, material over the fovea of the tenth segment, and another similar mass on the eleventh segment, near the base on the ventral face. Such secretions should prove interesting biochemically, as between species.

The pronotum usually is as long as wide, arcuate on either side from the apical margin to reach its greatest width at about apical three-fifths, thence narrowing and more or less sinuate to the basal bead. At basal four-fifths there is a large *median fovea,* and on either side a right and a left *lateral fovea.* These three foveae are always present. From each fovea a longitudinal sulcus extends apically. The *lateral sulci* and *median sulcus* show a great deal of variation, both between species and, to a certain extent, within the species population. The median sulcus may be entire, extending from median fovea to the apical margin or nearly so, as in *lineaticollis,* to obsolete *(luculentus).* The lateral sulci are similarly variable but have not been used as much in the taxonomy of the species.

The pronotal integument is more or less longitudinally elevated on the intervals between these sulci, to form two *longitudinal carinae,* and basally each carina ends in a basal *spine.* There is great interspecies variation here as well. The sculpture may be quite sharp, with ridge-like carinae ending in acute, conical spines, or the carinae may be short, longitudinal tumuli and the spines reduced to low, inconspicuous tubercles. Generally the three foveae and two spines lie in a transverse antebasal row. The carinae may be periodically raised into denticles or short re-

curved spines, and the basal fifth may also contain accessory spines and foveae. Commonly, the median basal fovea is connected to the basal margin by a short longitudinal carina.

The elytra have been used relatively little in species separation. The humeral *angles* may be produced, each ending in an acute spine or tooth (monstrosus), or may be rounded and unarmed *(foveicornis).* At the base of each elytron, beneath the humeral angle is a *subhumeraI fovea,* and on the dorsal surface three *basal elytral foveae,* the sutural, medial, and lateral. These foveae are usually nude, deep and well-formed. The lateral and sutural foveae lie at the origin of a short basal longitudinal sulcus, as a rule. The only species that does not have three basal elytral foveae is *ionae.* In this species both male and female sex have but two basal foveae on each elytron. The point has been made that *monstrosus* lacks the medial basal fovea, but this is incorrect. Both sexes of m*onstrosus,* and the types of *carolinae* and *cavicrus* have three basal elytral foveae on each elytron. This is another illustration of how remote *iona.* really is from the other members of the genus under discussion.

The abdomen has five visible tergites and five visible sternites, and since there is no lateral margin to the tergites, the abdominal segments can be seen as continuous rings. This lack of margins is a critical character for the tribe Batrisini. The first tergite has two *lateral carinae* on each side, an external straight carina and an internal, more or less oblique carina. These carinae of the first tergite are distinct, and the sub-triangular space enclosed between these carinae each side is analogous to the margin of this tergite in other pselaphid tribes of the area. The second and third tergites have lateral carinae, but these are quite small and not involved in the taxonomy of such a limited geographic area.

The base of the first tergite is divided into three deep depressions by pair of *basal abdominal carinae.* These latter vary in size as between the species, and in amount of proximity, and hence the relative site of the basal depressions vary as well.

The first three abdominal segments are seen as continuous rings, but the fourth is laterally clearly divided by a suture into an obvious tergite and sternite, whereas the fifth segment has the tergite (often known as the *pygidium)* and fifth sternite freely movable dorsoventrally to allow voiding of waste products from the anus, and the extrusion of the aedeagus in the male.

The last (fifth visible) sternite is often modified in the male sex. This modification usually takes the form of a median depression, which may be transverse *(fossicauda)* or elongate *(bistriatus).* Another type of modification involves the posterior external portions of this sternite. These may be elevated into a right and left tumulus *(frontalis),* or into setose tubercles *(furcatus).*

The sternal foveae have not been utilized in the taxonomy of some groups. These have been discussed at length elsewhere (Park, 1942) and may form a future aid in species discrimination in *Batrisodes.*

The metasternum is usually more prominently swollen in the males than in the females, and is generally medianly impressed.

The large, membranous wings are fringed with long, delicate setae, and are used to support the animal during its dusk flight, discussed later.

The legs are usually modified as between the sexes. Often this is a quantitative difference, the males having more swollen femora, especially the prothoracic, than the females. In addition, there are a number of qualitative modifications between the sexes, and since these are species specific; they are made use of in the taxonomy.

The prothoracic tibiae may be strongly produced at the center of the dorsal face to form a broadly triangular tooth *(monstrosus),* or a slender, acute spine *(armiger) in* the males, whereas the females have the tibiae unarmed in these species (P1. III, 7).

The prothoracic tarsi may have the large primary claw simple in the male and female of a species (Pl. III, 9). This is the rule in the genus. On the other hand, a few species have the male with the primary claw distinctly bifid on the prothoracic tarsi (Pl. III, 10, 11), as in *furcatus, virginiae,* and *frontalis.*

The mesothoracic femur may have the dorsal face abruptly and semi-circularly incised at apical third *(monstrosus* and *armiger)* in the males and simple in the females; or the ventral face may bear a long, arcuate, blunt spine at basal third (P1. III, 8) in the males of *ionae* and *schaumi,* but the females have these femora normal.

The mesothoracic tibia may bear a long *tibial spur,* as in *globous,* or the tibia may not have this spur, as in *cavicornis.* Again, the apical margin of the ventral face of this tibia, may be extended as an acute spine, as in *monstrosus.* The difference here is that the tibial spur is a long pencil of very approximate setae, whereas the apical spine is a solid, sclerotized portion of the integument.

The mesothoracic tarsi are especially important. Although previously unreported, the males of the eastern species may be abruptly separated into two groups,, depending upon whether the mesotarsi are simple (P1. III, 5) or abnormal (Pl. III, 6). As will be seen from the illustrations, in the simple type the second tarsal segment or *tarsomere* is compressed-cylindrical; in the abnormal type the second tarsomere is deeply incised on the ventral face

The modification of the metathoracic legs is seen chiefly in the presence or absence of tibial spurs. This is ,a species specific rather. than a sexual difference, but utilization of this character usually requires patience,

and has occasioned some confusion. Thus, a few eastern species lack metathoracic tibial spurs *(monstrosus, armiger, cavicrus, carolinae).* In this category the tibial apex bears no integrated pencil of setae (Pl. III, 3, 4). Second, *ionae,* although usually placed in the group lacking tibial spurs, and appearing on casual examination to agree in this particular, has a spur developed from the center of the ventroapical margin rather than from the side, and this peculiar condition is masked by a fringe of long setae on either side of pencil. Third, most species have distinct tibial spurs developed on the side of the tibial apex, but these spurs may be short and acute (P1. III, 2), as in *globosus,* or long and truncate (Pl. III, 1), as in *foveicornis.*

The tarsi of the metathoracic legs are usually simple, the last two segments being compressed-cylindrical (Pl. III, 1, 2, 3). In *armiger* the second tarsomere is greatly swollen and ovate (Pl. III, 4).

The *aedeagus* has been discussed in general phylogenetic terms, as well as specifically for eastern species of American *Batrisodes* (Park, 1942, p. 15-17, Pl. I, II, III). It is important both for the finer discrimination of closely allied species, and to obtain a broad view of pselaphid phylogeny. During the past five years more data have been accumulated, and these will be presented later. [2]

In the key that follows, the student must be able to sex the material at hand. Obviously, the best demonstration of sex in *Batrisodes* is the presence or absence of the aedeagus. This can be obtained by (a) direct dissection of the specimen, (b) examination of the cleared specimen in prepared slides, or (c) if the beetles are killed in ether, chloroform or carbon tetrachloride, the aedeagus will often be extruded. Even when collected in ethyl alcohol, this will sometimes occur.

If the aedeagus is not sought for, the specimen may still be sexed with a reasonable degree of success by observing whether or not it has one or more of the male secondary sex characters noted in the previous pages. To summarize these modifications, if a specimen lacks all of the following features it is probably a female; if it has two or more of the following features it is a male:

1. Front transversely excavated between the antennae.
2. Large eyes with more than twenty facets,
3. Front or clypeus bearing spines, teeth or tubercles.
4. Antennomeres I, III, VII, IX, X or XI all or partially abnormal.
5. Primary protarsal claw bifid.
6. Protibia bearing a dorsal tooth or spine.

[2] Morphological data on the aedeagus, and an accessory key to the species based on the aedeageal structure and form will be given in a paper nearing completion on the pselaphids of the Chicago Area.

7. Mesofemur abruptly incised dorsally in apical third, or bearing a large blunt spine ventrally at basal third.
8. Second tarsomere of middle leg abruptly incised on ventral face.
9. Second tarsomere of hind leg greatly swollen and wider than tibia.
10. Last visible sternite medianly depressed, or apically tuberculated on each side.

KEY TO MALES OF AMERICAN SPECIES OF BATRISODES EAST OF THE ROCKY MOUNTAINS

The following key to males of eastern species populations of *Batrisodes* is complete with respect to recognized species. It has been drawn up almost entirely from direct examination of type specimens, paratypes, and material compared with types by the author. There are six species for which this is not so. I do not know *clypeonotus* (Brendel), *tridens* Casey, *luculentus* (Casey), *virginiae* (Casey), *caseyi* Blatchley, or *kahli* Bowman. In these six cases original descriptions have been followed as much as feasible.

The illustrations on Plates I to VII are drawn to the same scale unless otherwise noted, from specimens in the author's collection, or from type speci mens and paratypes in museum collections. As they have been drawn primarily for illustrating the keys, this will account for the absence of composite drawings of whole beetles, the lack of shading, and other details of pubescence and general punctation. The figures were all drawn under very strong illumination, with 6.8 objectives and 9 X oculars.

Since the key characters are discussed in the preceding section, this material should be studied before using the keys for identification of specimens.

1	Mesothoracic femur with a conspicuous, blunt, slightly arcuate, subcylindrical spine at basal third of posteroventral face (P1. III, 8)	2
	Mesofemur not as above	3
2 (1)	Antennomere VII with the apex of external face gradually formed into an acute spine at right angles to the long axis of the segment (P1. II, 8)	*schaumi* (Aubé).
	Antennomere VII not as above, transverse (Pl. 11, 7)	*ionae* (LeConte).[3]
3 (1)	Metathoracic tibia with an apical spur (P1. III, 1)	8
	Metathoracic tibia with apical spur absent (Pl. III, 3)	4

[3] Furthermore, *ionae* is the only species in the area under study that has only two basal foveae per elytron.

4 (3) Occiput with three apically converging carinae: a median, and a right and left oblique carina 5
Occiput with a median longitudinal carina only 7

5 (4) Prothoracic tibia with a large tooth or tubercle near center of dorsal face (P1. III, 7) 6
Prothoracic tibia not as above ca*vicrus* Casey.

6 (5) Second tarsomere of metathoracic tarsus greatly swollen and ovate, nearly as wide to wider than tibial apex (P1. III, 4)
armiger (LeConte).
Second tarsomere of metathoracic tarsus simple, compressed-cylindrical, much narrower than tibial apex (P1. III, 3)
monstrosus (LeConte).

7 (4) Pronotum with several acute, recurved spines in a longitudinal row on each side. of disk *carolinae* Casey.
Pronotal disk without these recurved spines *confinis* (LeConte).

8 (3) Antennomere XI with a distinct basal spine (P1. II, 1, 2) 9
Antennomere XI with basal spine absent 10 [4]

9 (8) Antennomere IX more than twice as wide as long, with the mesial face produced as a wide, thin, setigerous plate (Pl. II, 2)
riparius (Say).
Antennomere IX only slightly wider than long, and without the spinoid plate (Pl. II, 1) *uncicornis Casey.*

10 (8) Antennomere X with the ventral face bearing a fovea or an excavation (Pl. II, 3, 4, 5, 9, 13; V, 4; VI, 1, 2, 5) 11 [5]
Antennomere X with the ventral face simple, not foveate or excavated (Pl. VII, 1) 26

11 (10) Vertexal foveae pubescent 12
Vertexal foveae nude 13

12 (11) Antennomere I with the ventral face produced ventrally as a conspicuous glabrous spine or a rounded-triangular process (Pl. II, 10, 11; VII, 5) 38
Antennomere I with the ventral face simple, or very abnormal, but not as described above (Pl. II, 12) 28

[4] The eleventh antennal segment of *nigricans* has the basal margin of the ventral face produced as a just discernible, minute denticle. This species is keyed out as though this denticle were absent.

[5] The fovea of the tenth antennal segment may be very conspicuous or so minute that it will be overlooked unless requisite illumination, magnification and care are used. The surface should be clean. The fovea may be central, basal or eccentric; deep and perforate, or in several steps; nude or pubescent.

13 (11) With the specimen oriented so that the face can be examined directly from the front or from a lateral view: the front is transversely excavated (Pl. I, 1), or is transversely impressed (Pl. I, 2) between the antennal cavities 18

With the specimen oriented as above: the front is simply declivous and strictly continuous with the clypeus, never transversely excavated or impressed (Pl. I, 3) 14 [6]

14 (13) From a strictly lateral view, the rugosely punctured head has the vertex evenly convex, and the frontoclypeus is strongly dedivous at an angle of about forty-five degrees (Pl. I, 3); last sternite with a median, rather deep excavation that is longer than wide (Pl. V, 1, 2) 15

From the same view, the rugosely punctured head is evenly declivous from a point between the eyes to the apical margin of clypeus at an angle of about twenty degrees; median depression of last sternite shallow, and slightly wider than long (Pl. V,3) 17

15 (14) Median longitudinal sulcus of pronotum vestigial, not extending on disk; integument between the vertexal foveae lightly punctate *bistriatus* (LeConte).

Median longitudinal sulcus of pronotum long, extending on disk to apical four-fifths; entire top of head rugosely punctate 16

16 (15) Median excavation of fifth sternite entire, subacute-oval (Pl.V, 1) *lineaticollis* (Aubé). [7]

Median excavation of fifth sternite with subparallel sides, bluntly closed apical end, but basal end open on each side (Pl. V, 2) *cartwrighti* Sanderson.

17 (14) Head through the eyes not wider than pronotum; fovea of antennomere X large, covering basal three-fourths of ventral face *fossicauda* Casey.

Head through the eyes distinctly wider than pronotum; fovea of antennomere X smaller, covering basal half of ventral face *declivis* Casey.

18 (13) Antennomere X wider than XI (Pl. II, 4) 19

Antennomere X as wide as XI or narrower than XI (Pl. II, 5) 21

[6] This interpretation of the front must be clearly understood if the specimens are to key out correctly (see p. 48).

[7] I have not seen the type specimen of *lineaticollis* (Aubé). The standard of reference used was the example of this species in the LeConte collection.

19 (18) Front strongly produced anterior to a line passing through bases of first antennal segments 20

Front abruptly declivous between antennal bases, this declivity densely setose and terminating in a pair of blunt median teeth *spretus* (LeConte).

20 (19) Lower margin of the overhanging frontal arc produced medianly into a thin, dark-brown, translucent triangular plate; this plate at right angles to the front, conspicuous, and turned ventrally at its apex (this may give the appearance of a pair of contiguous, right-triangular teeth over the deep frontal excavation) *beyeri* Schaeffer.

Lower margin of the overhanging frontal arc not produced, but medianly biarcuate, the median apex of the biarcuation, and the lateral apex each side continuing posteroventrally as carinoid ridges into the deep frontal excavation (Pl. I, 1); very common in the area *globosus* (LeConte).

21 (18) Antennomere XI with the ventral face normally convex 22

Antennomere XI with the ventral face abnormal in some particular, and dissimilar to the convexity of the dorsal face: flattened, concave, excavated, or medianly angulated (P1. II, 3, 5, 6; VI, 5) 25

22 (21) Vertex between the foveae relatively smooth and impunctate to sparsely punctulate 23

Vertex between the foveae obviously, coarsely and densely punctate, granulate, or scabrous 39

23 (22) Occipitovertexal area bisected by a median longitudinal carina 24

This area with no trace of such a carina, the surface perfectly smooth and convex sc*haefferi* new species.

24 (23) Mesothoracic tarsi normal (Pl. III, 5), the dorsal and ventral outlines of the second tarsomere parallel in lateral view 37

Mesothoracic tarsi abnormal (P1. III, 6, 12), the ventral out- line of the second tarsomere deeply notched in lateral view *rossi* new species.

25 (21) Antennomere XI elongate and as wide as X, with the ventral face flattened in basal half to basal two-thirds (PI. II, 5, 6; VI, 5) 40

Antennomere XI distinctly wider than X, with the ventral face concave in basal two-thirds (Pl. II, 3) *cavicornis* Casey.

26 (10) Antennomeres II to X inclusive submoniliform, all wider than long *caseyi* Blatchley.
Antennomeres II to X not all wider than long 27

27 (26) Vertexal foveae pubescent *striatus* (LeConte).
Vertexal foveae nude 29

28 (12) Antennomere I with ventral face normally convex; ventral margin of overhanging front medianly developed into a pair of blunted, rounded-triangular teeth *striatus psotai* new variety.
Antennomere I with ventral face inflated ventrally, this inflation flattened and densely, minutely pubescent (Pl. II, 12); ventral margin of overhanging front developed into a small rounded-triangular lobe *schmitti* Casey.

29 (27) Antennal club abnormal: IX and X with ventral faces flattened; external apical angle of IX produced in a spinoid process; XI with ventral face flattened, and the basal half broadly and gently concave (Pl. II, 9) *antennatus* Schaeffer.
Antennal club not as described above 30

30 (29) Antennomere I with mesial face bearing a large, oval, minutely granulate-punctate concavity *tridens* Casey.
Antennomere I not as described above 31

31 (30) Antennomere I with mesial face flattened, this flattened area divided into a smooth dorsal and a granulated ventral portion *clypeonotus* (Brendel).
Antennomere I not as described above 32

32 (31) Median longitudinal pronotal sulcus long, extending from median basal fovea to near the apical pronotal margin 36
This sulcus short to obsolete, never extending to more than apical fourth of total pronotal length 33

33 (32) With the head seen directly from above, the front extends as a long, gradually angulated arc, the apex of which is on a line passing through the anteriorly directed apices of the first antennomeres *frontalis* (LeConte).
With the head seen directly from above, the front is declivous on a line passing through bases of the anteriorly directed first antennomeres 34

34 (33) An entire circumambient sulcus connects the two vertexal foveae 35
Circumambient sulcus 'not entire, deeply impressed near each vertexal fovea but wholly obsolete apically *luculentus* (Casey).

35 (34) Frontal declivity densely punctate, each fine puncture bearing a short, coarse, blunt, flavous seta *punctifrons* (Casey).

Frontal declivity less uniformly punctate, the punctures less abundant medially, and each puncture bearing a very fine, inconspicuous, hairlike seta (Pl. V, 9) *appalachianus* Casey.

36 (32) Median vertexal carina extending over occiput, vertex, and to the glabrous semicircular excavation of the frontal declivity (Pl. VII, 2) *temporalis* Casey.

Median vertexal carina not extending on the frontal declivity *kahli* Bowman.

37 (24) Anterior margin of clypeus ogival in outline, as seen from above, that is, arcuate-triangular with a median point *furcatus* (Brendel).

Anterior margin of clypeus transversely truncate *virginiae* (Casey).

38 (12) Antennomere III longer than either II or IV, the mesioventral face slightly to strongly swollen or tumid (Pl. II, 11; VII, 5) *nigricans* (Leconte).

Antennomere III slightly shorter than II, perfectly simple and elongate (Pl. II, 10) *denticollis* (Casey) .

39 (22) Last sternite simply convex, with a small concave impression at basal fourth *sinuatifrons* (Brendel) .

Last sternite medianly concave, with the apical angles produced into conspicuous, rounded tubercles *scabriceps* (LeConte) .

40 (25) Face with the front declivous between antennal bases, the greatly narrowed declivity separated from the clypeus by a very shallow and feeble transverse impression, the declivity simple (P1. I, 2) *foveicornis* (Casey).

Face with the front broadly arcuate and extended beyond the antennal bases, then declivous to a slightly undulated, sharply defined frontal margin; face transversely excavated beneath this margin, the excavation densely setose *hairstoni* new species.

TENTATIVE KEY TO THE FEMALES OF BATRISODES EAST OP THE ROCKY MOUNTAINS

The following key to females is tentative and admittedly incomplete. It is on a different qualitative level from that of the preceding key to males. In the first place, a great many species have been described upon the male sex alone. Of these latter species only a few have had the female sex later associated with them without reservation. The following key has been compiled on direct comparative examination of those females that could be given a definite name with reasonable assurance. Consequently the key covers only about half of the known species of *Batrisodes* in the area under study.

1 Eyes rudimentary, consisting of from 6 to 14 facets; tibia with apical spur absent (MONSTROSUS GROUP) (Pl. III, 3) 2

Eyes normal, prominent, consisting of 40 or more facets; tibia with apical spur present (Pl. III, 1, 2) 5

2 (1) Occiput with three apically converging carinae: a median, and a right and a left oblique carina 3

Occiput with only a median longitudinal carina *confinis* (LeConte).

3 (2) Lateral pronotal margin bearing a posteriorly directed spine on each side, behind middle of length (Pl. VI, 3) *sandersoni* new species.

Lateral pronotal margins lacking this spine (Pl. VI, 4) 4

4 (3) Relatively large, 2.4 to 2.6 mm. long *monstrosus* (LeConte).

Relatively small, 1.7 to 2.0 mm. long *cavicrus* Casey.

5 (1) Antennomere VII slightly abnormal, the external apical angle varying from being slightly produced to formed into a subtriangular tooth *schaumi* (Aubé).

Antennomere VII normal 6

6 (5) Each elytron with only two basal foveae *ionae* (LeConte).

Each elytron with three basal foveae (the sutural fovea may be inconspicuously placed near suture) 7

7 (6) Vertexal foveae pubescent (NIGRICANS GROUP) 8

Vertexal foveae nude 11

8 (7) Antennomere III slightly longer than II *nigricans* (LeConte).

Antennomere III distinctly shorter than II 9

9 (8) Frontoclypeal declivity bisected by a median longitudinal carina or carinoid ridge; lateral vertexal carinae strong and well-developed from temporal angles to antennal tubercles; median vertexal canna strong and entire from cervicum to center of vertex on a line apical to the anterior eye margins

schmitti Casey.

Frontoclypeal declivity lacking median longitudinal carina or carinoid ridge; lateral vertexal carinae tending to be poorly developed, usually developed on temporal angles but not reaching antennal tubercles; median vertexal carina generally poorly developed, often only on cervicum and cervical sulcus, rarely extending to center of vertex 10

10 (9) Top of head distinctly and rather suddenly narrowed on a line passing just apical of anterior eye margins; apical clypeal margin tending to be upturned or medianly elevated

denticollis (Casey).

Top of head much more square in outline, the narrowing anterior of the eyes much more gradual and slight; apical clypeal margin tending to be simple and not medianly elevated *striatus* (LeConte).

11 (7) Face between antennal tubercles very coarsely and conspicuously punctate or scabrous 12

Face between antennal tubercles smooth, shining, glabrous to minutely punctulate or minutely granulate 14

12 (11) Frontoclypeal very gently and uniformly declivous from front to apical clypeal margin; front and clypeus not obviously differentiated (LINEATICOLLIS GROUP) *lineaticollis* (Aubé).

bistriatus (LeConte).

fossicauda Casey.

declivis Casey

Frontoclypeus vertically declivous 13

13 (12) Face uniformly and coarsely scabropunctate from interantennal line to ventral border of clypeus (SCABRICEPS GROUP)

scabriceps (LeConte).

tempotalis Casey.

Face with front vertically declivous and coarsely scabropunctate, and clypeus conspicuously concave, finely granulated and ending in a thin, laminoid, apically-directed margin

sinuatifrons (Brendel).

14 (11) Face bisected longitudinally by a dorsoventral carina or a carinoid ridge from the interantennal line of the front to the apical margin of the clypeus; most common species in the area under discussion *globosus* (LeConte)

Face not as described 15

15 (14) Front and clypeus finely and densely granulate, granulate-punctate, or granulate-reticulate 16

Front (not necessarily clypeus) glabrous to sparsely punctate or sparsely granulate or undulated 17

16 (15) Humeral angle of each elytron armed with a small, distinct tooth; face relatively shining and less densely punctate-granulate *frontalis* (LeConte).

Humeral angle of elytra not armed; face densely granulate 19

17 (15) Looking directly into face, there is .a transverse to concave interantennal roll connecting the antennal tubercles, and consequently the entire circumambient sulcus ends behind this roll 18

Looking directly into face, there is no interantennal frontal tumulus or transverse roll connecting antennal tubercles, and consequently the entire circumambient sulcus ends far forward, with the median portion of its wall on the frontal declivity *cavicornis* Casey.

18 (17) Looking directly downward on top of head, the interantennal roll between antennal tubercles is straight and transverse, and the face is subvertically declivous; humeral elytral angles smooth and rounded *beyeri* Schaeffer.

Looking directly downward on top of head, the frontal roll is indistinct and V-shaped, and appears to merge insensibly into the sloping facial declivity; each elytron with an oblique humeral tumulus armed at its posterior angle by a very minute denticle *furcatus* (Brendel).

19 (16) Median subbasal fovea of pronotum connected to basal bead of pronotum by a strong and entire carina *antennatus* Schaeffer.

This carina either wholly absent or not entire 20

20 (19) Integument between punctures smooth and polished *punctifrons* (Casey).

Integument between punctures very finely alutaceous *schaefferi* new species.

DIAGNOSES AND DISTRIBUTION OF PREVIOUSLY DESCRIBED SPECIES

In this section are discussed the several recognized species of the area under survey and their zoogeographic ranges.

There has, been no attempt to redescribe each species in detail since a large part of this would be needless repetition of anatomy common to the *genus* as a whole. Rather, attention has been paid to the critical features of each population, especially with respect to the male sex.

These morphological matters are followed by the material examined in terms of collections studied and literature on the subject. I am indebted to many people for the privilege of studying the pselaphids under their care. In addition to private collections, noted in diagnoses that follow, I take this opportunity to thank W. J. Gerhard, Rupert Wenzel and Henry Dybas of the Chicago Natural History Museum (C.N.H.M.) for permission to study the collections of W. J. Gerhard, Dr. Frank Psota, H. F. Wickham, A. B. Wolcott, and F. W. Nunenmacher; H. S. Barber of the U. S. Bureau of Entomology and Dr. E. A. Chapin and Dr. R. E. Blackwelder of the U. S. National Museum (U.S. N.M.) for facilities in studying the Thomas L. Casey collection; Dr. Harlow B. Mills, the late Dr. T. E. Frison, Dr. H. H. Ross and Dr. Milton Sanderson for favors received while studying the pselaphids deposited at the Illinois Natural History Survey (I.N.H.S.); Dr. Hugo G. Rodeck for the loan of two pselaphids from the University of Colorado Museum; Dr. Joseph C. Bequaert for permission to study the John L LeConte and the H. C. Fall collections at the Museum of Comparative Zoölogy (M.C.Z.).

Specimens in the author's private collection (O.P.) include the collection of the late Charles F. A. Schaeffer. [8]

Batrisodes ionae (LeConte)

Diagnosis: Male. This is a large, shining heavy-bodied species. It is very isolated among the American species of the genus. The pubescence, although sparse, is long, more or less bristling and erect on head, pronotum and elytra, with the setal tips frequently sharply recurved. This gives a downy aspect to the body.

The antennae are massive for the genus, with segments, II, IV, V, VI, VII, VIII, IX and X transverse and III quadrate; VIII is distinctly smaller than VII or IX; ventral face of X flattened; XI with a short basal tooth at ventromesial corner.

[8] The type specimens of the pselaphids described by Charles Schaeffer, as well as some paratpes, are in the collections of the U. S. Bureau of Entomology; paratypes are in the author's collection. This note is appended to avoid possible confusion as to place of deposition of the type.

Occiput-vertex very tumid; top of vertexal tumidity with a median foveoid depression; no median vertexal carina; lateral vertexal carinae very sharp on posterior half of head; vertexal foveae small, deep, nude; face declivous, vertical between antennae, not transversely impressed or excavated; gular suture distinct, and guIar fovea deep.

Last sternite with a deep, transverse impression near basal margin.

Each elytron with two basal foveae only.

Prothoracic legs with primary tarsal claw bifid. Mesothoracic legs with femur bearing a long, translucent, slightly arcuate, very blunt spine near center of ventroposterior face; tarsi normal. Metathoracic legs with tibia bearing a dense brush of setae on mesial face, a few of these setae longer at apical margin to give a false tibial spur.

Female. As for male save that the intermediate antennal segments are less massive; ventral face of X. simply convex; XI without a basal spine. claw of prothoracic tarsi not bifid; mesothoracic femur not bearing a spine. Last sternite shorter, with a more feeble and arcuate basal impression.

DISTRIBUTION

Published Records. Georgia (LeConte, 1850); Georgia (Brendel and Wickham, 1890); Vigo and Crawford Counties, Indiana (Blatchley, 1910); Georgia, Pennsylvania, Indiana (Leng, 1920; Bowman, 1934).

Material Examined: Slade, Powell County, KENTUCKY (O.P.); White Mountains and Summit, Union County, NEW JERSEY (OP.); Enola, Cumberland County, PENNSYLVANIA (O.P.).

DISTRICT OF COLUMBIA (MCZ); GEORGIA (MCZ type 6158); Palisades, Bergen County and Lakehurst, Ocean County, NEW JERSEY (MCZ).

The next five species, and a new species described in a later section, form the *monstrosus* group. This group is discussed in general terms and the several species keyed out later.

***Batrisodes monstrosus* (LeConte)**

Diagnosis: Male. This is a large, shining, sparsely pubescent species. Antennae with segment VIII with lateral face slightly produced; IX flattened on ventral face; X with an oblique excavation on mesioventral face; XI simple, not spined at base.

Occiput-vertex with three carinae, a median longitudinal and a right and a left oblique. These three carinae tend to converge apically to form subtriangular surface from 'base to center of occiput. The lateral oblique carinae are constant; there is a tendency for the median to vary from strong to short or interrupted. Vertexal foveae small but appearing large as each fovea occupies a, depression. Eyes large, prominent, of about fifty facets. Face simple, declivous at an angle of about forty degrees, and not transversely impressed or excavated between antennal cavities.

Pronotum with the discal longitudinal carinae each represented by two or three recurved spines in apical half, and a prominent conical antebasal spine.

Elytra with three basal foveae on each elytron, the sutural fovea placed very near the suture; humeral angles each with a distinct tooth.

Last sternite long, medianly flattened and subglabrous.

Prothoracic legs with tibia deeply arcuate for basal half, with a small triangular cusp at base and a very prominent rounded triangular tooth at center of dorsal face; primary tarsal claw not bifid. Mesothoracic legs with femur bearing a deep, semicircular notch at apical four-fifths of dorsal face; tibia with a long arcuate, apically directed spine at apex of ventral face; tarsi normal. Metathoracic trochanter with a prominent arcuate, acute spine at apex; tibia with tibial spur absent; tarsi normal, compressed-cylindrical.

Female. As for male save that antennal segments IX, X and XI are not modified; median vertexal carina shows even a greater tendency to be short or absent; eyes rudimentary, small, composed of from six to twelve facets; all legs simple; last sternite shorter, not medianly flattened, pubescent.

DISTRIBUTION

Published Records: Athens, Clarke County, Georgia, Ohio and Pennsylvania (LeConte, 1850); Washington, District of Columbia (Schwarz, 1896); Northern States east of the Mississippi River (Brendel and Wickham, 1890); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); throughout Indiana (Blatchley, 1910); Georgia, Pennsylvania, Ohio, Indiana (Leng, 1920); New York (Leonard, 1928); Pennsylvania to Indiana, south to Georgia (Bowman, 1934) ; Peoria, Illinois (Park, 1935).

Material Examined: DELAWARE (O.P.); DISTRICT OF COLUMBIA (O.P.); Clayton, Rabun County, GEORGIA at 2000-3700 feet (O.P.); Peoria, Peoria County, Springfield, Sangamon County, and Urbana, Champaign County, ILLINOIS (O.P.); Crothersville, Jackson County, INDIANA (O.P.); Silver Lake, Wyoming County and Staten Island, NEW YORK (O.P.); Harrisburg, Dauphin County, PENNSYLVANIA (O.P.).

Bowmanville, Cook County, ILLINOIS and Lake Forest, Lake County, ILLINOIS (CNHM); Tioga County, PENNSYLVANIA (CNHM); Staten Island, NEW YORK (CNHM).

ILLINOIS (INHS); Plummers Island, MARYLAND (INHS).

Type specimen from GEORGIA (MCZ type 6161); DISTRICT OF COLUMBIA (MCZ); Stelton, Middlesex County, NEW JERSEY; Fredericksburg, Spotsylvania County, VIRGINIA (MCZ).

Batrisodes ferox (LeConte)

This is placed as a variety Of *monstrosus* by Leng (1920, p. 129). Varietal status is not warranted. The type (MCZ type 6162) is a female and does not show any unusual structural development within the range of variation of the *monstrosus* population.

DISTRIBUTION

Published Records: Ohio and Pennsylvania (LeConte, 1850); Northern States east of the Mississippi (Brendel and Wickham, 1890); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); Pennsylvania, Ohio and Indiana (Leng, 1920); New York (Leonard, 1928).

Material Examined: Type (MCZ 6162).

***Batrisodes cristatus* (LeConte)**

This is placed as a variety of *monstrosus* by Leng (1920, p. 129). Varietal status is not warranted. The type (MCZ type 6163) is an immature or callow female and does not show any unusual development of morphology within the range of variation of *monstrosus.*

DISTRIBUTION

Published Records: Pennsylvania (LeConte, 1850, and Leng, 1920).

Material Examined: Type (MCZ 6163).

***Batrisodes armiger* (LeConte)**

Diagnosis: Male. This is a bizarre relative of *monstrosus.* It differs from the preceding diagnosis in the following structural features. Antennal segment IX is transverse, with ventral face shorter than dorsal face, and produced as a thin shelf; X with a larger, deeper excavation on ventral face; XI with a sinuate ventral face, and the basal fifth produced into a thick, oblique, prominent spine.

The third and fourth visible sternites have a brush of long, flavous, mesially recurved setae on the ventrolateral aspect.

The median tooth on the dorsal face of the prothoracic tibia is very high and slender, lanceolate.

The second tarsomere of the metathoracic legs is greatly swollen and ovate and as wide to wider than tibia (Pl. III, 4).

DISTRIBUTION

Published Records: Pennsylvania. (LeConte, 1850); Allegheny Mountains, Pennsylvania (Brendel and Wickham, 1890); Pennsylvania (Leng, 1920); Allegheny Mountains (Bowman, 1934); Sunburst, North Carolina (Brimley, 1942).

Material Examined: Near Steinhatchee River, FLORIDA (OP.).
Type specimen from PENNSYLVANIA (MCZ· type 6160).

***Batrisodes cavicrus* (Casey)**

Diagnosis: Male. Antennae simple. Head with prominent eyes and well developed lateral vertexal carinae. Occiput with three apically converging carinae: a median longitudinal carina, and a right and a left oblique carina. These three carinae strong; the median varying within the population from an undulated, entire ridge to an interrupted or serrate carina. An extreme of this latter condition is reached in which the median occipital carina ends between the vertexal foveae in an elevated, triangular tooth, and a detached tooth or spine arises from the

vertex anterior to the vertexal foveae. Vertexal foveae deep and nude; circumambient sulcus entire, greatly lengthened anteriorly, between the antennal tubercles, where the sulcus is involved with the facial declivity. Face declivous, not transversely excavated; front separated from clypeus by an angulated carina; clypeus simple.

Pronotum with a discal row of two acute, recurved teeth on each side of the median sulcoid impression. The interruption of the discal carinae into several isolated, recurved teeth may be viewed as a parallel to the similar tendency for the median occipital carina to become interrupted. These discal pronotal carinae are common features for many species of *Batrisodes*, but *the monstrosus* group generally has these carinae represented by these isolated teeth, and, finally, in *confinis*, these teeth disappear as well. In *cavicrus* the lateral pronotal margins are not spinose, in contrast to sandersoni and *carolinae.*

Each elytron with three nude basal foveae.

Fifth visible (last) sternite deeply concave medianly for apical three-fourths of length.

Prothoracic legs with unmodified tibia, and With primary tarsal claw not bifid.

Mesothoracic legs with femur unmodified, and tarsi normal.

Metathoracic legs abnormal. Trochanter with a sinuate spine at apex. Femur with dorsoventral diameter increased, anterior face pubescent and convex, posterior face glabrous and concave, to produce a median concave area, the ventral margin of which is abruptly sinuate at basal third.

Female as for male except that the eyes are rudimentary, the last sternite is convex save for a slight semicircular depression in basal half, and the metathoracic legs are unmodified

DISTRIBUTION

Published Records: Asheville, Buncombe County North Carolina (Casey, 1893); Crawford County, Indiana and Cincinnati, Hamilton County, Ohio (Blatchley, 1910); North Carolina and Indiana (Leng, 1920); Asheville, Buncombe County, North Carolina (Bowman, 1934); North Carolina (Brimley, 1938).

Material Examined: Type specimens, from Asheville, Buncombe County, NORTH CAROLINA (USNM); Sassafras Mountains, SOUTH CAROLINA (INHS).

***Batrisodes confinis* (LeConte)**

In the original description of this species LeConte (1850, p. 96) stated that it was based on a single female specimen, and this mistake has remained *perdu* these many years and probably was a cause for a synonym noted later. I have examined the type of *confinis* (MCZ type 6159) and find it to be a male with large prominent eyes of more than forty facets, and the posterior trochanters each armed with a hooked spine at the apex of the ventral face. The species is typical

of the *monstrosus* group in the absence of spurs on the posterior tibiae, and LeConte probably thought that his specimen was a female since it lacked the modifications of the antennae, anterior tibiae, and intermediate femora so typical of males of *monstrosus* and *armiger*.

Diagnosis: Male. Antennae simple. Head with a long median vertexal carina that bisects cervicum, cervical sulcus, occiput and ends on a line through the posterior eye margins; lateral vertexal carinae absent; eyes prominent, as normal for males of the *monstrosus* group; vertexal foveae deep, nude, on a line posterior to the eyes; deep circumambient sulcus entire, its apical margin medianly angulated; face for transversely excavated or impressed between antennal cavities, the frontoclypeus bearing a Y-shaped carina; this carina has an arm extending obliquely to a point near the base of the first antennal segment, and the two oblique arms unite medianly to form a single carina that extends nearly to the apical margin of clypeus.

Pronotum with discal lateral carinae absent, and lacking also the recurved teeth that represent these carinae in *cavicrus* and *carolinae.*

Each elytron with apparently two, but in reality three, basal foveae (Pl. V, 5), the sutural fovea being deeply recessed beneath the sutural margin.

Last (fifth visible) sternite bearing a conspicuous, semicircular depression in basal two-thirds, the straight basal edge of this depression being parallel with the apical margin of the fourth visible sternite.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with tibia bearing a strong spine at apex of ventral face, and tarsi normal (Pl. V, 6).

Metathoracic legs with trochanter bearing a strong, arcuate spine at apex of ventral face; tibia not bearing an apical spur.

DISTRIBUTION

Published Records: Athens, Clarke County, Georgia (LeConte, 1850); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); Putnam County, Indiana (Blatchley, 1910); Georgia; Indiana (Leng, 1920); Georgia and Putnam County, Indiana (Bowman, 1934); Raleigh, Wake County, North Carolina (Brimley, 1942).
Material Examined: Type from GEORGIA (MCZ 6159).

Batrisodes curvatus Sanderson

This is a synonym of *confinis* (LeConte). I have studied the types of *confinis* and of *curvatus* and find them identical. It is wholly understandable how the synonym was formed in view of the mistaken sex of *confinis* and its obscurity over the past century.

In the original description of *curvatus,* the posterior tibiae are stated to have apical spurs. This was probably a typographical error, as the type specimen does not have such spurs.

DISTRIBUTION

Published Records: Clemson, Oconee County, South Carolina (Sanderson, 1940).

Material Examined: Holotype male, from the above locality (INHS).

***Batrisodes carolinae* (Casey)**

This species is known only from the male sex. It is readily separated from its allies by the following combination of features. (1) The occiput has the median longitudinal carina well formed, but lacks the right and left oblique occipital carinae. (2) The pronotum has the discal carinae represented by two series of longitudinally recurved spines, as in *cavicrus*. (3) Each lateral pronotal margin bears a posteriorly-directed spine, as in *sandersoni.* (4) The anterior legs are simple, as in *cavicrus.*

DISTRIBUTION

Published Records: Asheville, Buncombe County, North Carolina (Casey, 1893); North Carolina (Leng, 1920); Asheville, Buncombe County, North Carolina (Bowman, 1934); North Carolina (Brimley, 1938).

***Batrisodes schaumi* (Aubé)**

Diagnosis: Male. Antennae with segment VII with the ventroapical face produced into a gradually formed, triangular tooth at right angles to long axis of segment; XI with an apically arcuate spine at basal margin of ventral face.

Occiput-vertex rather tumid, median vertexal carina variable from present over vertex and occiput to absent on vertex but present as a bisector of the cervicum nod cervical sulcus; lateral vertexal carinae sharp and well developed; vertexal foveae deep and nude; antennal incisures deep and pubescent; eyes large and prominent. Face greatly narrowed between antennal cavities, declivous between antennae at an angle of about forty-five degrees, simple, not transversely impressed or excavated between antennal cavities.

Each elytron with three basal foveae.

Prothoracic legs with primary tarsal claw not bifid. Mesothoracic legs with femur bearing a long, arcuate, very blunt spine at basal third of ventral face; tibia with a long, oblique spine on posterior *face* at apical four-fifths, partially obscured by a brush of setae; tarsi normal Metathoracic legs with tibia bearing a long apical spur. First sternite medianly longitudinally carinoid.

Female. Unique in the area under study by having abnormal antennae, segment VII as in the male save that the triangular tooth is variable in size, at times as well-formed as some males, in other specimens only slightly produced; XI not spined at base. Face as in male save that it is less narrowed between antennal cavities. Legs simple, lacking the

male modifications. Sutural and discal basal elytral foveae close together, and very rarely the discal fovea is obsolete. First visible sternite relatively normal, not bearing a long, strong median longitudinal carina.

DISTRIBUTION

Published Records: Pennsylvania and Illinois (Brendel and Wickham, 1890; Leng, 1920; Bowman, 1934); New York (Leng and Nicolay, in Leonard, 1928); Palos Park, Cook County, Illinois (Park, 1935).

Material Examined: Palos Park, Cook County, ILLINOIS (O.P.); Warrens Woods, Lakeside, Berrien County, MICHIGAN (O.P.); Fort Lee, Bergen County, NEW JERSEY (O.P.); Central Park, New York, NEW YORK (O.P.); St. Vincent, PENNSYLVANIA (O.P.).

Magnolia, Putnam County, ILLINOIS (INHS).

St. Vincent, Westmoreland County, PENNSYLVANIA (MCZ); Fredericksburg, Spotsylvania County, VIRGINIA (MCZ).

Batrisodes punctatus (LeConte)

As noted by Leng (1920, p. 129), this is a synonym of *schaumi*. The type of *punctatus* (MCZ 6167) is a female, and both this and the males in LeConte's series agree perfectly with *schaumi*.

DISTRIBUTION

Published Records: Athens, Clarke County and (?) Nacoochee ("Nakutshique"), White County, Georgia (LeConte, 1850); Georgia (Leng, 1920).

***Batrisodes riparius* (Say)**

Diagnosis: Male. Antennae with segment IX very transverse, the lateral face produced as a thin, setigerous platform, so that the segment is two to four times wider than long, often in a width to length ratio of 15 to 7; X with a very deep fovea covering almost all of ventral face; XI sinuate, with a large conical spine at basal margin of ventral face (P1. II, 2).

Median vertexal carina and lateral vertexal carinae well developed; vertexal foveae deep and nude; eyes large and prominent. Face with the front declivous between the antennae, granulate-punctate, transversely excavated between antennal cavities, the overhanging frontal margin medianly arcuate-rounded and setigerous.

Each elytron with three basal foveae.

Prothoracic legs with primary tarsal claw not bifid. Mesothoracic legs with tarsi abnormal, the second tarsomere compressed, slightly arcuate, and with the ventral face deeply notched at center. Metathoracic legs with tibia bearing a long apical spur.

DISTRIBUTION

Published Records: Georgia and Pennsylvania (LeConte, 1850); Country along the Ohio River (Brendel and Wickham, 1890); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); Posey County, Indiana (Blatchley, 1910); Missouri, Georgia, Pennsylvania (Leng, 1920); New York (Leonard, 1928); Pennsylvania, to Georgia and west to Missouri (Bowman, 1934); Palos Park, Cook County, Illinois (Park, 1935).

Material Examined: Urbana, Champaign County and Palos Park, Cook County, ILLINOIS (O.P.); Staten Island, NEW YORK (O.P.); St. Vincent, PENNSYLVANIA (O.P).

Fox Ridge State Park, ILLINOIS (INHS).

ILLINOIS (MCZ); St Vincent, Westmoreland County, PENNSYLVANIA (MCZ).

***Batrisodes uncicornis* Casey**

Diagnosis: Male. This species is closely allied to, but quite distinct from, *riparius.* The antennae have segment IX only a little wider than long commonly in a width to length ratio of 9 to 7, and the segment consequently lacks the thin external shelf (Pl. II, 1); X with a deep excavation on ventral face; XI with an oblique spine from basal margin of sinuate ventral face.

Head similar to *riparius* except that the frontal declivity is not as abrupt, and the overhanging frontal margin is less rounded and more pointed medianly over the deep transverse excavation between the antennal cavities.

Elytra with three basal foveae on each elytron.

Prothoracic legs with primary tarsal claw not bifid. Mesothoracic legs with abnormal tarsi, but the degree of abnormality much less than in *riparius,* the ventral face of the second tarsomere less abruptly arcuate in basal half. Metathoracic legs with a long tibial spur.

DISTRIBUTION

Published *Records:* New York City, *New* York (Casey, 1897); New Jersey and New York *(Leng,* 1920); New York (Leonard, 1928); New York City and vicinity (Bowman,*1*934); Raleigh, Wake County, North Carolina (Brimley, 1942); Mobile and Baldwin Counties, Alabama (Löding, 1945).

Material *Examined: Palisades, Bergen* County, NEW JERSEY (O.P.); Central Park, New York, NEW YORK (O.P.). Type specimen from New York examined November 12, 1941 (USNM).

Raleigh, Wake County, NORTH CAROLINA (INHS).

Batrisodes juvencus (Brendel)

This species is unknown to me. It may be a synonym of *riparius* (Say). It was not listed in the Leng "Catalogue" (1920), and according to Bowman (1934, p. 65), has not been recognized.

The only published record of its distribution is that of Brendel, who stated that the species was described on a specimen taken by him in "Northern Illinois" while describing the species (Brendel, 1865, p. 258). Later (Brendel, 1866, b 36) it was stated that the type specimen was a female.

Batrisodes scabriceps (LeConte)

Diagnosis: Male. Antennae segment I with mesial face stronly granulated, in contrast to shining remainder of antenna; segment X as wide XI and bearing a large fovea on ventral face (Pl. II, 13).

Head (Pl. VI, 8) with long, strong median and lateral vertexal carinae; vertexal foveae deep and nude, each fovea at base of a deep, glabrous, slightly arcuate foveal impression, these impressions not uniting apically; eyes prominent, and composed of relatively large facets; dorsal surface of head very coarsely scabropunctate. Front narrowed between antennal articulations, then abruptly and vertically declivous. This frontal declivity semicircularly excavated (Pl. VII, 3) in median half of width, the complex excavation glabrous, with carinoid lateral walls, and bearing two pairs of conical tubercles, a median pair that is basally contiguous and projects anteriorly from the base of the frontal margin, and a lateral pair in which one tubercle is placed above and lateral of each median tubercle. The front deeply and transversely excavated, between antennal cavities, beneath this complex overhanging frontal margin.

Each elytron trifoveate.

Last (fifth visible) sternite medianly concave and laterally tuberculate, as in *furcatus.*

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with normal, simple tarsi.

Metathoracic legs with tibia bearing a stout apical spur.

DISTRIBUTION

Published Records: Pennsylvania, Illinois and Iowa (Brendel and Wickham, 1890); Iowa City, Johnson County, Iowa (Wickham, 1896); New Jersey, Pennsylvania, Illinois and Iowa (Leng, 1920); New York (Leonard, 1928); New Jersey to Iowa (Bowman, 1934); Warrens Woods, Lakeside, Berrien County, Michigan (Park, 1935).

Material Examined: Type specimen (MCZ 6166); St. Vincent, Westmoreland County, PENNSYLVANIA (MCZ).

Brownfield Woods, Urbana, Champaign County, ILLINOIS (O.P.); Warrens Woods, Lakeside, Berrien County, MICHIGAN (O.P.); Cambria County, PENNSYLVANIA (O.P.).

St. Vincent, Westmoreland County, PENNSYLVANIA (CNHM).

Washington County, ARKANSAS (INHS); Platte City, Platte County, MISSOURI (INHS).

Batrisodes harringtoni Casey

This is a synonym of *scabriceps* (LeConte).

DISTRIBUTION

Published Records: Ottawa, Canada; BayeId, BayfieId County, Wisconsin and Westmoreland County, Pennsylvania (Casey, 1897 and Bowman, 1934); Canada, Wisconsin and Pennsylvania (Leng, 1920); Raleigh, Wake County North Carolina (Brimley, 1942).

Material Examined: Types from type localities cited above (USNM).

Batrisodes temporalis Casey

Diagnosis: Male. This well-marked species is a member of the *scabriceps* group. The antennae are simple, with segment X relatively small for *Batrisodes* males, and not foveate or excavated on its ventral face (Pl. VII, 1).

Head trapezoidal, with long subparallel tempora longer than the prominent eyes; vertex with well-developed lateral vertexal carinae. The median vertexal carina is diagnostic, extending from occiput anteriorly where it bisects the entire vertex and continues over the front into the frontal declivity. This is the longest median vertexal carina known to the author. Frontal declivity in general as described for *scabriceps*, save that the limits of the glabrous, semicircular excavation are not sharply defined in *temporalis* and the two pairs of conical tubercles in this glabrous field are oriented differently. These points between *scabriceps* and *temporalis* are illustrated for comparison (Pl. VII, 2, 3). Vertexal foveae deep and nude; circumambient sulcus incomplete and replaced by a deep, oblique sulcus extending anteriorly from each vertexal fovea; from, save for median glabrous area on declivity, and the anterior part of the vertex scabropunctate; posterior part of vertex sparsely granulate; front excavated between the antennal cavities, beneath the overhanging frontal margin.

Median, longitudinal pronotal sulcus very long, extending almost to the apical pronotal margin.

Each elytron with three deep, nude basal foveae.

Fifth sternite as in *scabriceps* and *furcatus.*

Aedeagus long and slender (P1. VII, 4).

Prothoracic legs with the tarsi relatively very short and thick for *Batrisodes*, the tarsal claw very long and obliquely angulate.

Mesothoracic legs with normal tarsi.

Metathoracic legs with tibia bearing an apical spur.

DISTRIBUTION

Published Records: Westmoreland County, Pennsylvania (Casey, 1897; Bowman, 1934); Pennsylvania (Leng, 1920).

Material Examined: Type specimen from above locality (USNM).

St. Vincent, Westmoreland County, PENNSYLVANIA (MCZ).

Batrisodes frontalis (LeConte)

Diagnosis: Male. This is a large species with glistening integuments and sparse, subappressed, bright, flavous setae; the setae on the maxillary palpi and those of the genal beard are bristling and conspicuous. The antennae are long, simple, unmodified save for segment I. This latter

segment has the ventral face pinched into a ventrally dilated, oblique pyramidal process.

The long head has the median vertexal carina bisecting the cervicum, deep cervical sulcus and occiput, to end on the elevated posterior portion of the vertex; the lateral vertexal carinae are well-developed on the posterior portion of the vertex; the vertexal foveae are deep and nude, on a line through the posterior eye-margins; these foveae are connected by a very long circumambient sulcus that occupies the anterior half of the vertex. The eyes are prominent. The antennal incisures are deep and complex. The front is elevated on the top of the head between the antennal insertions, and then becomes declivous, so that the frontal declivity formed extends well anteriad of the antennal bases, and may reach medianly to the anterior margins of the anteriorly-directed first antennomeres. This gives a broadly-rounded frontal arc, when seen from above, similar to that of *globosus*, *beyeri*, and some other species. The ventral margin of this frontal declivity is strongly biarcuate, and overhangs the deep frontal excavation that extends between the antennal cavities. This facial excavation is bounded ventrally by a long, anteriorly-directed, laterally densely setose process of the clypeus.

Each elytron has three deep, nude basal foveae.

The last sternite is medianly flattened and laterally tuberculate.

The prothoracic legs have inflated femora; the second tarsomere has a spur of semi-agglutinated setae that diverge obliquely from the apex of its lateral face; the primary tarsal claw is apically blunt and bifid (P1. III, 11). The mesothoracic legs have normal tarsi. The metathoracic legs have the tibia bearing an apical spur.

DISTRIBUTION

Published Records: [9] Pennsylvania (LeConte, 1850); between the thirty-sixth parallel and the (Great) lakes (Brendel and Wickham, 1890); Colorado Springs, El Paso County, Colorado (Wickham, 1898); Iowa City, Johnson County, Iowa (Wickham, 1900); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); Pennsylvania, Missouri and Wisconsin (Casey, 1908); Pennsylvania, Missouri and Wisconsin (Leng, 1920); Pennsylvania to Missouri and northward (Bowman, 1934); White Heath, Piatt County, Illinois (Park, 1935).

Material Examined: [9] Glenview, Cook County, ILLINOIS (CNHM); Iowa City, Johnson County, IOWA (CNHM); Buena Vista, Chaffee County and Colorado Springs, El Paso County, COLORADO (CNHM); Springfield, Sangamon County and Brownfield Woods, Urbana, Champaign County, ILLINOIS (O.P.); PENNSYLVANIA (O.P.); Rochester, Olmsted County, MINNESOTA (O.P.)

ILLINOIS (INHS); Baldwin City, Douglas County, KANSAS (INHS).

Type specimen from PENNSYLVANIA (MCZ 6165); IOWA (MCZ); Aweme, MANITOBA, CANADA (MCZ).

[9] The Colorado records of *Batrisodes frontalis* and *B. globosus* are of such interest that they form the substance of a later section of this article.

The next five species form the *lineaticollis* group. This assemblage is easily distinguished as a group, but the several species that compose it are separated with difficulty and a considerable amount of confusion in identification has further complicated the taxonomy.

This group consists of: *lineaticollis* (Aubé), *bistriatus* (LeConte), fossicauda Casey, declivis Casey, and *cartwrighti* Sanderson.

All of them have the same sure yet almost indefinable habitus of close relationship. Notable features of this habitus are the prominent, relatively finely faceted eyes; the broad head that is conspicuously granulate-punctate; the simple face that is lengthily declivous; the front that is neither transversely impressed nor excavated between the antennal cavities; the male sex with the tenth antennal segment foveate on the ventral face and with the last sternite bearing a distinct median impression.

***Batrisodes lineaticollis* (Aubé)**

Diagnosis: Male. The antennae are simple and unmodified, with the exception of segment X which is relatively large and bears a large, deep fovea on its ventral face.

The head has the median vertexal carina and lateral vertexal carinae well developed; vertexal foveae deep and nude; eyes large and prominent. Vertex slightly declivous at an angle of about twenty degrees from center, on a line through eye-centers, to a point on a line between antennal articulations; from this latter point, the front becomes suddenly more declivous, at an angle of about forty-five degrees, and this fronto-clypeal declivity continues uninterrupted so the anterior clypeal margin. Consequently the face is neither transversely impressed nor excavated between the antennal cavities (P1. I, 3), although there are two vague longitudinal, ovate impressions on frontal declivity between the antennae. The entire dorsal surface of the head is rather roughly sculptured, this sculpture becoming especially obvious on the face in the form of coarse punctures and granular denticles (Pl. VII 6).

The median longitudinal sulcus of the pronotum is long, having a length, in relation to the total pronoral length, of 5 to 7 respectively. On the other hand, the sulcus is nor "entire," and does not reach the apical pronotal margin as suggested in the original figure of Aubé (1833, P1. 90, fig. 3).

Each elytron with three basal foveae.

Lest sternite bearing a median depression that is oval and slightly longer then wide, as illustrated (Pl. V, 1).

Prothoracic legs with the primary tarsal claw not bifid. Mesothoracic legs with normal tarsi. Metathoracic legs with apical tibial spurs.

Female. As for male save that antennal segment X is normally small and not foveate on its ventral face; last sternite much shorter and lacks a median depression.

DISTRIBUTION

Published Records: America Septentrionali (Aubé, 1833); Georgia and Pennsylvania (LeConte, 1850); Pennsylvania (Brendel and Wickham, 1890); Iowa City, Johnson County, Iowa (Wickham, 1894); Cincinnati, Hamilton County, Ohio (Blatchley, 1910, p. 326); Pennsylvania and Georgia (Leng, 1920); New York (Leonard, 1928) ; Pennsylvania and Georgia (Bowman, 1934).

Material Examined: South Orange, Essex County and Newfoundland, Morris County, NEW JERSEY (O.P.) Amagansett, Suffolk County, Long Island, NEW YORK (O.P.).

NEW JERSEY (MCZ) .

As noted above, the published range covers almost the entire area under study, and all of the ranges of the five species that make up the group. Actually, *lineaticollis sensu strictiore* would appear to be limited in its distribution, on the basis of material seen, and it probably does not occur outside of the northeastern section.

Batrisodes bistriatus (LeConte)

This species is closely allied to *lineaticollis,* and the diagnosis of the latter may be used for *bistriatus* except for two critical features: (1) the area of the head bounded by the circumambient sulcus anteriorly, and laterally by the vertexal foveae is subimpunctate in *bistriatus,* in sharp contrast to the coarsely punctate-scabroid integument external to this area; whereas in *lineaticollis* the entire dorsal surface of the head is punctate-granulate. (2) The median longitudinal sulcus of the pronotum is obsolete in *bistriatus,* not reaching the center of the disc; whereas in *lineaticollis* it extends over the disc.

DISTRIBUTION

Published Records: Pennsylvania (LeConte, 1850; Brendel and Wickham, 1890; Leng, 1920; Bowman, 1934) .

Material Examined: PENNSYLVANIA (MCZ type 6172); Cornwall, Litchfield County, CONNECTICUT (MCZ).

This species also appears to be restricted in its range, from Pennsylvania northward into New England.

Batrisodes cartwrighti Sanderson

This species is allied closely to *lineaticollis.*

Diagnosis: Male. Median vertexal carina present but obscured by the granules of the integument; lateral vertexal carinae fine, arcuate, entire; eyes prominent; vertexal foveae deep and nude, on a line through the posterior margins of the eyes; whole dorsal surface of head roughly sculptured,

granulate on occiput and vertex between the foveae, becoming very coarsely punctate on the face. From a lateral view, the vertex is convex, and the frontoclypeus is rather abruptly declivous at as angle of about forty-five degrees to near the apical clypeal margin, where the surface flattens out. Head slightly wider through the eyes than the pronotum, in a ratio of about 7.8 to 7. Antennae (P1. V, 4) as in *lineaticollis.*

Median pronotal sulcus as in *lineaticollis;* that is, about four-fifths the pronotal length.

Each elytron with three distinct, deep, nude basal foveae.

Last (fifth visible) sternite (Pl. V, 2) diagnostic. The median excavation having subparallel, minutely serrulated sides, the apical end closed, the basal end open as a narrow sinus on each side of an arcuate, raised and glabrous basal tumulus. This depression in *lineaticollis* and *bistriatus* (Pl. V, 1) is also longer than wide, but is subacute-oval in outline, and both apical and basal acute ends are closed.

Prothoracic legs with primary tarsal claw not. bifid.

Mesothoracic legs with normal tarsi, and the tibia bearing an apical spine on ventral face.

Metathoracic legs with tibia bearing an apical spur.

DISTRIBUTION

Published Records: Clemson, Oconee County, South Carolina (Sanderson, 1940).
*Material E*xamined: Holotype male, from above locality (INHS).

***Batrisodes fossicauda* Casey**

After Casey (1897, p. 574) had described this species it was placed as a doubtful synonym of *bistriatus* (LeConte) by Raffray (1908, p. 159). Casey (1908, p. 262) refuted this synonomy and stated in what particulars these two species differed. Leng (1920, p. 129) again placed *fossicauda* as a questionable synonym of bistriatus. Bowman (1934, p. 68) again established *fossocauda,* remarking "From the descriptions, the present species *(fossicauda)* seems to be distinct, and it seems best to retain it until the matter is settled."

I have studied the types of *foddicauda* at the U.S. National Museum, especially paratype 38669, and agree with Casey and Bowman that *fossicauda* is a distinct species Actually, it is more closely related to *lineaticollis.*

Diagnosis: Male. In general very similar to *lineaticollis,* but separable on two critical features: (1) The roughly punctured head of *fossicauda* has the declivity starting at a point between the eyes on the center of the vertex, and continuing apicoventrally to the apical clypeal margin at an even angle of about twenty degrees; whereas in *lineaticollis, bistruatus* and *cartwrighti* the declivity is in two steps. (Pl. I, 3), the roughly

punctured head having the vertex slightly declivous to a line passing through the antennal tubercles at about twenty degrees, then the front becomes much more strongly declivous at an angle of about forty-five degrees. (2) The last sternite of *fossicauda* has a weakly defined, shallow depression that is transversely oval (Pl. V, 3); whereas in *lineaticollis, bistriatus* and *cartwrighti* (Pl. V, 1, 2) the depression is deeper, and longer than wide.

DISTRIBUTION

Published Records: Westmoreland County, Pennsylvania (Casey, 1897); Iowa City, Johnson County, Iowa (Wickham, 1900); Pennsylvania and Connecticut (Leng, 1920); Westmoreland County, Pennsylvania (Bowman, 1934).

Material Examined: PENNSYLVANIA (OP.); type and paratypes, Westmoreland County, PENNSYLVANIA (USNM); PENNSYLVANIA (MCZ).

The published records report this species as far north as Connecticut and as far west as Iowa. This is undoubtedly the result of confusion of this species with others in the group. At present the limited material suggests a more restricted range.

Batrisodes declivis Casey

Diagnosis: Male. This species is closely allied to *fossicauda,* in both the long, even facial declivity and, the weakly formed, transversely oval depression of the last sternite.

The species may be separated from *fossicauda* on two features: (1) The head in *declivis* is distinctly wider through the eyes than the pronotum, whereas the head and pronotum are subequal in width in *fossicauda.*. (2) The fovea of the ventral face of antennal segment X is smaller, covering the basal half of the area, in *declivis,* whereas this fovea covers the basal three-fourths of the ventral face in *fossicauda.*

DISTRIBUTION

Published Records: Iowa City, Johnson County, Iowa (Casey, 1908; Bowman, 1934); Iowa (Leng, 1920).

Material Examined: Iowa City, Johnson County, IOWA (CNHM), (MCZ).

This would appear to be a population occupying the western portion of the deciduous forest formation. It is possible that *declivis, fossicauda, cartwrighti,* and *bistriatus* are variations of *lineaticollis* but in the absence of long series of each, covering all of the territory occupied by the group, no basis exists for such an assumption. On the limited material available, these five populations appear to be distinct species. Direct genetical experiments and palaeontological data are lacking.

Batrisodes antennatus Schaeffer

Diagnosis: Male. This is a very shining, blackish brown species with contrasting, sparse, flavous pubescence and light brown appendages. The antennae have segments I to VIII simple and unmodified, but the

club is very abnormal (Pl. II, 9) as follows: segment IX transverse, with the ventral face produced obliquely into a long, pyramidal spine; X transverse, with the ventral face very irregularly flattened and excavated; XI exceptionally large for the genus, with the flattened ventral face bearing a broad, shallow, oval concavity on the ventral half.

Head lacks a median vertexal carina, but the lateral vertexal carinae are long and entire, from antennal incisures to temporal angles; vertexal foveae deep and nude. Face with the front declivous from a line through antennal articulations, at an angle of about thirty degrees. This frontal declivity narrows rapidly, and terminates on a line passing through eye centers, when the head is examined from a direct anterior view; the frontal declivity is rounded-triangular in outline, and covered with very minute flavous setae. This declivity is separated abruptly from the clypeus by a deep, narrow transverse excavation between the antennal cavities.

Each elytron with three nude, deep, basal foveae.

Fifth (last visible) sternite is short and unmodified and convex.

Prothoracic legs with primary tarsal claw not apically bifid. Mesothoraric legs with abnormal tarsi, the second tarsomere is medianly strongly notched on its ventral face. Metathoracic legs with the tibia bearing a thick apical spur.

Female. As for male, except that the antennal club is perfectly simple; the face evenly declivous at an angle of about thirty degrees, and is not transversely impressed or excavated, the dorsal surface of the head is strongly shining and subglabrous, but the apical three-fourths of the facial declivity is granulate-punctate; mesothoracic tarsi simple and normal.

DISTRIBUTION

Published Records: Black Mountain, Buncombe County, North Carolina (Schaeffer, 1906); North Carolina (Leng, 1920); Black Mountain, Buncombe County, North Carolina (Bowman, 1934); North Carolina (Brimley, 1938).

Material Examined: Male and female paratypes, Black Mountain, Buncombe County, NORTH CAROLINA (O.P.); Hamrick, Yancey County, South Toe River Valley, NORTH CAROLINA (O.P.).

Batrisodes beyeri Schaeffer

Diagnosis: Male. Antennae with segment X wider than XI, and its ventral face bearing a small, circular fovea in basal fifth.

Head with median vertexal carina present but of variable length and strength; lateral vertexal carinae present from antennal incisures to temporal angles, but not easily discerned; vertexal foveae deep and nude. Front gently declivous and rapidly narrowed from antennal articulations to a point passing through anterior third of anteriorly directed basal antennal segments, then front abruptly and vertically declivous and

medianly carinoid to the overhanging frontal margin; frontal margin blackened and medianly produced in a thin, dark, triangular plate; this plate medianly sulcate and turned abruptly ventral at apex, so that the plate *appears* to consist of two right-triangular, contiguous teeth. Face below the overhanging frontal margin deeply, transversely excavated between antennal cavities. The medianly erected clypeus and the frontal plate fringed with a spray of long flavous setae.

Elytra with three deep, nude basal foveae on each elytron.

Last visible (fifth) sternite simply convex.

Prothoracic legs with primary tarsal claw not apically bifid, but under a 10 X objective is seen to be apically, obliquely grooved as though the bifidation were either incipient or vestigial.

Mesothoracic legs with normal, simple tarsi.

Metathoracic legs with tibia bearing a stout apical spur.

Female. As for male except that antennas segment X is normally smaller and unmodified, and the face is evenly declivous and not transversely excavated.

This species is allied to *globosus,* and may be a specialized montane species of the *globosus* group, restricted to the southern Appalachian mountains.

DISTRIBUTION

Published Records: Black Mountain, Buncombe County, North Carolina (Schaeffer, 1906); North Carolina (Leng, 1920); Black Mountain, Buncombe County, North Carolina (Bowman, 1934); North Carolina (Brimley, 1938).

Material Examined: Male and female paratypes, Black Mountain, Buncombe County, NORTH CAROLINA (O.P.); Hamrick, Yancey County, South Toe River Valley, NORTH CAROLINA (O.P.).

***Batrisodes globosus* (LeConte)**

This is the best known, most abundant, and most widely distributed species of the genus in the Western Hemisphere.

Diagnosis: Male. Antennae with segment X distinctly wider than XI and bearing a small, circular fovea at basal five-sixths of ventral face (Pl. II, 4).

Head (Pl. I, 1; IV, 1) with long, strong median and lateral vertexal carinae; vertexal foveae deep and nude, connected by an entire circumambient sulcus; head coarsely punctate external to this sulcus and the enclosed space of vertex lightly punctulate; antennas incisures well developed; eyes prominent. Front gradually narrowed and extended between antennal articulations as a long arc, as in *frontalis,* the surface gradually declivous, with the apex of this frontal arc on a line between the apical thirds of the anteriorly-directed basal antennomeres. This frontal arc, from a direct facial view, is medianly continued ventroposteriorly as a median carinoid ridge, and laterally, between this median ridge and

each basal antennomere, the frontal margin is continued ventroposteriorly in a strong, cuneiform ridge. Face deeply and transversely excavated beneath this overhanging frontal margin, between the antennal cavities. Clypeus medianly bearing a setose, apically-directed tubercle.

Each elytron trifoveate at base.

Last (fifth visible) sternite simple.

Prothoracic legs with primary tarsal claw not bind.

Mesothoracic legs with tibia bearing a strong apical spur, and with simple, normal tarsi (Pl. III, 5)

Metathoracic legs with tibia bearing a relatively small, acute apical spur (P1. III, 2).

Female. As for male, except that antennomere X is normally smaller than XI and not ventrally foveate; face evenly declivous and consequently not transversely impressed or excavated.

DISTRIBUTION

Published Records: [9] Georgia and Pennsylvania (LeConte, 1850); East of the Mississippi River (Brendel and Wickham, 1890); Colorado Springs, El Paso County, Colorado (Wickham, 1898); Iowa City, Johnson County, Iowa (Wickham, 1900); Cincinnati, Hamilton County, Ohio (Duty, 1903, 1908); throughout Indiana (Blatchley, 1910); Connecticut, Vermont, Florida, Indiana (Leng, 1920); New York (Leonard, 1928); Palos Park, Cook County, Illinois (Holmquist, 1928); Carlson Woods, near Razorback Lake, Sayner, Vilas County, Wisconsin (Park, 1932); Palos Park, Cook County, Illinois (Park, 1929); Eastern States (Bowman, 1934); Pales Park, Cook County, Illinois (Park, 1935a); Peoria, Peoria County, and White Heath, Piatt County, Illinois and Greenwood, Johnson County, Indiana (Park, 1935b).

Material Examined: [9] Spring Valley, Bureau County; Urbana, Champaign County, Chicago, Des Plaines and Palos Park, Cook County; Wheaton, DuPage County; Yorkville, Kendall County; Volo, Lake County; Algonquin, McHenry County; Peoria, Peoria County; White Heath, Piatt County; Putnam, Putnam County; Oakwood, Vermilion County; Enfield, White County; Rockford, Winnebago County, ILLINOIS (O.P.). Crothersville, Jackson County; Greenwood, Johnson County; Davis Woods at Smith, Laporte County; Gloyeski Woods at Chesterton, mesophytic pockets at Ogden Dunes, and Indiana Dunes State Park at Tremont, Porter County, INDIANA (O.P.). Elizabethtown, Hardin County and Mammoth Cave National Park, Edmonson, KENTUCKY (O.P.). Vowells Mill, Natchitoches Parish, LOUISIANA (O.P.). Warrens Woods at Lakeside, Berrien County, MICHIGAN (OP.). Fairview, Bergen County and South Orange, Essex County, NEW JERSEY (OP.). Massapequa, Nassau County, NEW YORK (O.P.). OHIO (O.P.). Enola, Cumberland County, PENNSYLVANIA (O.P.). TENNESSEE (O.P.). Cam bridge and Madison, Dane County and Sayner, Vilas County, WISCONSIN (O.P.).

Midland County, MICHIGAN (R. R. Dreisbach).

Boulder, Boulder County, COLORADO (U. Colo. Mus.)

Hemmingford and Fort Coulonge, QUEBEC, CANADA (CNHM); Colorado Springs, El Paso County, COLORADO (CNHM); Bowmanville, Chicago, Glenview, South Chicago, Tiedtville and Willow Springs, Cook County, and Antioch, Lake County, ILLINOIS (CNHM) INDIANA (CNHM); Iowa City, Johnson County, IOWA (CNHM); Marion, Plymouth County, MASSACHUSETTS (CNHM);

[9] See page 76.

St. Clair County, MISSOURI (CNHM); Cincinnati, Hamilton County, OHIO (CNHM); Nashville, Davidson County, TENNESSEE (CNHM); Reading, Berks County, PENNSYLVANIA (CNHM); Fredericksburg, Spotsylvania County, VIRGINIA (CNHM); WISCONSIN (CNHM).

Washington County, ARKANSAS (INHS); Quincy, Adams County, Mayview and Urbana, Champaign County, Palos Park, Cook County, LaSalle County, Mount Olive, Macoupin County, Alhambra, Madison County, Havana, Mason County, and Magnolia, Putnam County, ILLINOIS (INHS); Lawrence, Douglas County and Elk City, Montgomery County, KANSAS (INHS); Cheboygan County, MICHIGAN (INHS); Raleigh, Wake County, NORTH CAROLINA (INHS).

ILLINOIS (MCZ); INDIANA (MCZ); KENTUCKY (MCZ); Chatham, Barnstable County, Framingham and Lowell, Middlesex County, and Sharon, Norfolk County, MASSACHUSETTS; Marquette, Marquette County and Ann Arbor, Washtenaw County, MICHIGAN; Montclair, Essex County, NEW JERSEY; PENNSYLVANIA (MCZ type 6168); TEXAS (MCZ); Fredericksburg, Spotsylvania, VIRGINIA (MCZ).

***Batrisodes spretus* (LeConte)**

Diagnosis: Male. Antennae with segment I elongate, ventral face twice as long as wide, longer than II and III united, mesial face subgranular; X subspherical, slightly wider than XI, with a small, perforate fovea at basal fifth of ventral face as in *globosus* (P1. VI, 7).

Eyes moderately prominent; vertexal foveae nude; circumambient sulcus subangulated, the apical portion apparently opening into the oblique sulci of the frontal declivity; front declivous between antennal tubercles, bearing two oblique, poorly defined, setose sulci that arise medianly with or near the circumambient sulcus and extend to the frontal margin; frontal margin medianly produced into a pair of blunted, setose, conoidal tubercles; face transversely excavated between antennal cavities, beneath over hanging frontal margin. See P1. IV, 3 for a dorsal view of the head.

Each elytron with three nude basal foveae. Mesothoracic tarsi abnormal.

Metathoracic tibiae each with an apical spur.

DISTRIBUTION

Published Records: Nacoochee ("Nakutshi")?, White County, Georgia and Vermont (LeConte, 1850); Virginia, Ohio and Kentucky (Brendel and Wickham, 1890); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); southern half of Indiana (Blatchley, 1910); Indiana, Kentucky, Georgia, Ohio, Vermont and Virginia (Leng, 1920); Windsor, Broome County, New York (Notman 1920); New York (Leonard, 1928); northeastern states (Bowman, 1934).

MaterIal Examined: Enola, Cumberland County, PENNSYLVANIA (O.P.).

DISTRICT OF COLUMBIA (MCZ); GEORGIA (MCZ type 6170); ILLINOIS (MCZ); PENNSYLVANIA (MCZ); Alexandria, VIRGINIA (MCZ).

Batrisodes foveicornis (Casey)

Diagnosis: Male. Antennae with segment X as wide as XI, and bearing a large circular fovea in basal half of ventral face; XI with ventral face flattened in basal two-thirds (P1. II, 5, 6).

Head with median vertexal carina absent to short; lateral vertexal carinae interrupted and relatively slight; vertexal foveae deep and nude; each fovea at base of a long, slightly arcuate foveal impression, the impression terminating mesiad of an antennal articulation, and consequently the circumambient sulcus not well formed. Front declivous and subglabrous between antenna! articulations, the frontal declivity short and rapidly narrowed; front transversely impressed by a very short, shallow, but entire impression between the large antennal cavities, otherwise the face is simple (Pl. I, 2).

Each elytron with three basal foveae.

Last (fifth visible) sternite simple.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with abnormal tarrsi, the ventral face of second tarsal segment notched at center.

Metathoracic legs with tibia bearing a long apical spur (Pl. III, 1).

DISTRIBUTION

Published Records: Tennessee (Casey, 1887); Cincinnati, Hamilton County, Ohio (Brendel and Wickham, 1890); Iowa City, Johnson County, Iowa (Wick ham, 1896); Monroe County, Indiana (Blatchley, 1910); Tennessee, Ohio, Indiana (Leng, 1920); New York (Leonard, 1928); Tennessee (Bowman, 1934).

Material Examined: Types from TENNESSEE (USNM); TENNESSEE (O.P.); Mount Olivet, Robertson County, KENTUCKY (INHS).

Batrisodes cavicornis Casey

Diagnosis: Male. Antennae with segment X distinctly narrower than Xl, and bearing an exceptionally large, deep fovea on basal two-thirds to three-fourths of ventral face, the fovea in several steps (P1. II, 3); XI with ventral face obliquely concave in basal two-thirds.

Head with a rudimentary median vertexal carina that bisects cervicum, cervical sulcus and extends over occiput; lateral vertexal carinae entire and distinct; vertexal foveae deep and nude. Face essentially as in *foveicornis,* except that the rapidly narrowing frontal declivity has a more sharply defined ventral margin above the entire, but short transverse frontal impression.

Each elytron with three nude basal foveae.

Last (fifth visible) sternite simple.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with abnormal tarsi (Pl. III, 6), the second tarsomere suddenly notched on ventral face.

Metathoracic legs with tibia bearing a long apical spur.

Female. As for male except that the tenth and eleventh segments are simple; face simply and suddenly declivous, the declivity pubescent and not transversely impressed; mesothoracic tarsi simple.

DISTRIBUTION

Published Records: Westmoreland County, Pennsylvania (Casey, 1897); Pennsylvania and Ohio (Leng, 1920); Westmoreland County, Pennsylvania (Bowman, 1934).

Material Examined: Type from Westmoreland County, PENNSYLVANIA (USNM). Mammoth Cave National Park, Mammoth Cave, Edmonson County, KENTUCKY (OP.); Eddyville, Pope County, ILLINOIS (O.P.).

Cincinnati, Hamilton County, OHIO (MCZ); St. Vincent, Westmoreland County, PENNSYLVANIA (MCZ).

Batrisodes punctifrons (Casey)

Diagnosis: Male. Antennae not conspicuously modified, segment X similar to IX except that it is larger; segment XI very large, about twice as wide as X, and nearly as long as the four preceding segments united.

Head with median vertexal carina absent or vestigial, at times a vestige bisecting the cervical sulcus; lateral vertexal carinae entire, from the large antennal incisures to the temporal angles; vertexal foveae deep and nude; circumambient sulcus entire, V-shaped, the apical end at the origin of the frontal declivity. Front evenly declivous on a line through antennal articulations and apex of circumambient sulcus; frontal declivity rapidly narrowing between antennal cavities, to end in a narrow truncate frontal margin; this declivity densely punctate, each puncture bearing a short, coarse, blunt, flavous seta; this declivity separated from the clypeus by a narrow, deep, entire transverse sulcus between antennal cavities; clypeus medianly bearing a short setose tubercle, these setae and those of the truncate frontal margin obscuring the transverse facial sulcus. Pubescence of frontal declivity illustrated on Pl. V, 8.

Each elytron with three deep, nude, basal foveae.

Last (fifth visible) sternite medianly less pubescent and distinctly flattened from base to apex.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with very abnormal tarsi (Pl. III, 12), the second segment sinuate above and deeply notched below.

Metathoracic tibia with an apical tibial spur.

Female. As for male except that antennal segment is both actually and relatively smaller; face abruptly declivous, not transversely impressed, lower half of clypeofrontal declivity densely punctate, and setose; last sternite shorter, pubescent, and bearing a narrow, shallow concavity in basal half; mesothoracic tarsi normal.

DISTRIBUTION

Published Records: Pennsylvania (Casey, 1887); southern Pennsylvania (Brendel and Wickham, 1890); Pennsylvania (Leng, 1920); New York (Leonard, 1928); Pennsylvania (Bowman, 1934).

Material Examined: PENNSYLVANIA type (USNM); St. Vincent, PENNSYLVANIA (OP.)

Mt. Toby, MASSACHUSETTS (MCZ); Rumney, Grafton County, NEW HAMPSHIRE (MCZ); PENNSYLVANIA (MCZ).

***Batrisodes appalachianus* Casey**

Diagnosis: Male. This species is very closely allied to *punctifrons.* It may be separated by the character of the frontal declivity. In *appalachianus* the frontal declivity is less uniformly punctate, and instead of each puncture bearing a short, stiff, flavous, blunted seta as in *punctifrons,* each puncture bears a very fine, inconspicuous, hairlike seta. I have found the best discrimination of this condition to be under a magnification of a 10 X objective, with strong illumination. See P1. V, 9.

DISTRIBUTION

Published Records: Westmoreland County, Pennsylvania (Casey, 1908); Pennsylvania (Leng, 1920); Westmoreland County, Pennsylvania (Bowman, 1934).

Material Examined: Type from PENNSYLVANIA (USNM).

***Batrisodes virginiae* (Casey)**

I do not know this species, and have placed it near *furcatus* (Brendel) on the basis of its published description (Casey, 1884, p. 90). The vertexal foveae are nude, connected by a feeble circumambient sulcus. The surface included between this sulcus and occiput is impunctate whereas the surface external to this sulcus is densely and strongly punctate. Anterior margin of the clypeus is transversely truncate and below a bifid horn. This horn arises from a short, broad, muzzle-formed frontal declivity. This frontal muzzle is medianly tuberculate, and laterally dentate below. Apical the median tubercle, the muzzle narrows abruptly to form a flat, triangular, bifid horn noted above. Face transversely excavated beneath this overhanging frontal muzzle, between antennal cavities.

Prothoracic tarsi with the primary claw distinctly bifid, as in *furcatus.*

Metathoracic tibiae each bearing an apical spur.

Described from the male sex.

DISTRIBUTION

Published Records: Stone Creek, Lee County, Virginia (Casey, 1884); Virginia (Brendel and Wickham, 1890); Cincinnati, Hamilton County, Ohio (Duty, 1903, 1908); Virginia and Indiana (Leng, 1920); Stone Creek, Lee County, Virginia (Bowman, 1934); Round Knob, North Carolina (Brimley, 1938).

Batrisodes furcatus (Brendel)

Diagnosis: Male. Antennae with segment X subglobose, as wide as XI, with ventral face bearing a large fovea in basal two-thirds; XI simple, unmodified.

Head (Pl. IV, 2) with the median and lateral vertexal carinae well developed; vertexal foveae deep and nude; circumambient sulcus entire; eyes prominent. Front apically directed between antennal articulations as a flattened, narrowing shelf; the frontal, overhanging margin of this shelf is trilobed; the median lobe is slightly notched, and bears a pair of flavous, apically directed, strongly arcuate setiform processes; face deeply excavated beneath the trilobed frontal margin, between antennal cavities; clypeus long, with the apical margin medianly pointed.

Each elytron with three deep, nude, basal foveae.

Last (fifth visible) sternite medianly concave and laterally tuberculate.

Metasternum with a deep, narrow, median longitudinal sulcus.

Prothoracic legs with primary tarsal claw (Pl. III, 10) bifid.

Mesothoracic legs with tarsus normal.

Metathoracic legs with tibia bearing a short, bushy apical spur.

Female. Similar to male except that antennal segments X and Xl are smaller and unmodified; face simply and evenly declivous, and not transversely excavated between antennal cavities; apical clypeal margin medianly rounded; fifth sternite medianly flattened, not laterally tuberculate; metathoracic legs with apical tibial spur longer and more conspicuous.

DISTRIBUTION

Published Records: Southern Pennsylvania (Brendel and Wickham, 1890); Pennsylvania (Leng, 1920); southern Pennsylvania (Bowman, 1934).

Material Examined: Northern ILLINOIS (O.P.); Warrens Woods, Lakeside, Berrien County, MICHIGAN (O.P.); St. Vincent, PENNSYLVANIA (O.P.); Tiptonville, nr. Reelfoot Lake, Lake County, TENNESSEE (OP.).

Marion, Plymouth County, MASSACHUSETTS (FMNH); St. Vincent, and Reading, Berks County, PENNSYLVANIA (FMNH).

Thebes, Alexander County, Herod, Pope County, and Magnolia, Putnam County, ILLINOIS (INHS); Raleigh, Wake County, NORTH CAROLINA (INHS)

Marion, Plymouth County, MASSACHUSETTS (MCZ); St. Vincent, Westmoreland County, PENNSYLVANIA (MCZ); Fredericksburg, Spotsylvania County, VIRGINIA (MCZ).

Batrisodes sinuatifrons (Brendel)

Diagnosis: Male. Antennae placed at the lateral margin, so that they show the distinctive type of articulation to the roof of the epicranium, so characteristic of Pselaphidae, especially well; segment I elongate, thin, subconical, with the ventral face flattened; segment X as wide as XI, and bearing a fovea on the ventral face. This fovea is large, circular, deep, pubescent, and eccentrically placed in the mesiobasal portion of the ventral face. Segment X has the ventral face strongly flattened, so that the

segment appears subglobular from a dorsal view, and subsemicircular from a lateral view. Segment XI simple and unmodified. P1. VI, 1.

Head with the large, quadrate dorsal surface entirely and coarsely punctate, the punctures large and crowded; median vertexal caring present but very much obscured by the coarse punctures; lateral vertexal carinae strong from temporal angles to a point anterior to the eyes, where the carinae tend to slant externally and disappear; eyes prominent; vertexal foveae small and nude; circumambient sulcus absent, and represented by a short, straight impression extending apically from each vertexal fovea. Front very broad, declivous apical of the antennal articulations, then abruptly and vertically declivous. This vertical declivity short, and the overhanging frontal margin extended as a pair of conspicuous horns. These horns are extended ventrally; each horn is pendant obliquely ventrolaterad, conical, blunted, apically setose, the setae forming a pencil of golden setae that turns abruptly into the frontal excavation. Face deeply and transversely excavated beneath the overhanging frontal margin, between the antennal cavities.

Each elytron with three nude basal foveae.

Last (fifth visible) sternite simply convex-flattened, with a very small median concavity at basal fourth.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic tarsi normal.

Metathoracic tibia with an apical spur.

Female. As for male, except that the antennae are simple and unmodified; head with smaller dorsal surface, and the face is not transversely excavated. The face, nevertheless, is sharply marked into a dorsal, abruptly declivous front, between the antennal tubercles, that is coarsely and densely punctate, and a ventral, shining, subimpunctate clypeus. The apical clypeal margin is apically directed as a thin, shelf-like lamina. Last sternite evenly convex.

DISTRIBUTION

Published Records: Memphis, Shelby County, Tennessee (Brendel, 1893; Bowman, 1934); Tennessee (Leng, 1920).

Material Examined: Harahan, Jefferson Parish, LOUISIANA (INHS); Marianna, Lee County, ARKANSAS (INHS).
TENNESSEE (MCZ) .

Batrisodes clypeonotus (Brendel)

Diagnosis: Male. I do not know this species, and have selected the following features from the published description.

Antennal segment I abnormal, the mesial face with the dorsal half smooth and shining, and the ventral half granulated; segment X large, globose, with the ventral face not bearing a fovea; segment XI not as wide as the tenth.

Vertexal foveae nude; circumambient sulcus not entire apically; vertexal carina present; declivous front with a broadly biarcuate frontal margin; face transversely excavated between antennal cavities, beneath this overhanging frontal margin; excavation bearing a pair of distant, black teeth; clypeus medianly tuberculate, this tubercle medianly slightly carinated.

Each elytron with three basal foveae.

Posterior tibiae each with an apical spur.

DISTRIBUTION

Published Records: PonchatouIa, Tangipahoa Parish, Louisiana (Brendel, 1893; Bowman, 1934); Louisiana (Leng, 1920)

***Batrisodes luculentus* (Casey)**

Diagnosis: Male. I do not know this species, and have selected the following features from the published description.

Vertexal foveae nude; circumambient sulcus not entire apically; front declivous between antennae, the declivity longitudinally bi-impressed, the impressions setigerous; frontal margin bearing a pair of median teeth. Face transversely excavated between the antennal cavities, beneath the overhanging frontal margin.

Basal antennal segment with simple mesial face; segment X distinctly wider than Xl.

Posterior tibiae each with an apical spur.

DISTRIBUTION

Published Records: District of Columbia (Casey, 1887; Bowman, 1934; Leng, 1920).

The next four species form the *nigricans* group. These four are *nigricans* (LeConte), *denticollis* (Casey), *schmitti* Casey, and *striatus* (LeConte); they agree in a number of features, including the possession of pubescent vertexal foveae.

***Batrisodes nigricans* (LeConte)**

Diagnosis: Male. Antennae with several abnormalities, segment I with ventral face produced ventrally into a thin, conspicuous process that appears as a long, acute spine from a direct view of the mesial face, and as a subtruncate lobe from a direct view of the apical end of the segment; III longer than II or IV, with the mesial face slightly inflated in basal half (P1. II, 11); X as wide as XI, with a large, deep fovea located eccentrically in mesiobasal area; XI with the basal margin of ventral face produced into a minute dentiform tubercle.

Head with median vertexal carina countersunk; lateral vertexal carinae low and broad; eyes prominent; vertexal foveae deep and lightly

pubescent; circumambient sulcus opening apically into the front. Front deeply, longitudinally sulcate between the conspicuous antennal tubercles, then abruptly and vertically declivous, these areas heavily pubescent with bristling setae that obscure many details. The frontal declivity noted bears a pair of triangular, apically directed teeth at center, and between these teeth, and lower down, is a pair of minute tubercles. These details are difficult to discern unless high magnification and strong illumination are used. Beneath this overhanging frontal margin, the face is deeply, transversely excavated between the antennal cavities. Clypeus also complex, the most peculiar feature of which is the formation of a high, narrow, long, subtriangular roll or tubercle medianly.

Each elytron with three deep, nude basal foveae.

Last (fifth visible) sternite medianly broadly flattened, with the apical angles continuing this flattened area as flat-topped tubercles.

Metasternum medianly, longitudinally sulcate.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with normal tarsi.

Metathoracic legs with tibia bearing an apical spur.

Female. Antennae unmodified, save that segment III is slightly longer than II or IV; front deeply depressed between the conspicuous antennal tubercles, this median sinus broadening into the evenly declivous frontoclypeus; front not transversely excavated between antennal cavities; last sternite convex, except for a small median concavity at base.

DISTRIBUTION

Published Records: "Columbiam Car. Australis" (South Carolina) (LeConte, 1850); Georgia (Brendel, 1887; Brendel and Wickham, 1890); Cincinnati, Hamilton County, Ohio (Dury, 1903, 1908); Lake County, Indiana (Blatchley, 1910); South Carolina, Indiana and Connecticut (Leng, 1920); ? New York (Leonard, 1928); eastern states (Bowman, 1934).

Material Examined: Lakehurst, Ocean County, NEW JERSEY (O.P.); sphagnum bog at Wyandanch, Suffolk County (Long Island), *NEW* YORK (O.P.).

Denver, Denver County, COLORADO (FMNH). [9]

Wyandanch, Suffolk County (Long Island), *NEW* YORK (MCZ); SOUTH CAROLINA (MCZ type 6171).

There has been considerable confusion concerning *nigricans* and its allies. A part of this is a consequence of a series of errors resulting in the establishment of *triangulifer* on incorrect morphological grounds.

Batrisodes triangulifer (Brendel)

This is a synonym of *nigricans* (LeConte). To the author, at least, this came as a great surprise, and it was not until the type of *nigricans* was studied that the facts could be appreciated.

[9] See page 76.

Brendel (1887, p. 205) described *Batrisus spinifer* from Long Island, New York, stating that it differed from *nigricans* in having the "first antennal joint bearing a sharp thorn perpendicularly, causing the joint to appear triangular" in the male. In this paper, Brendel figured this antennal structure (1887, p. 205, fig. 1 and 2), and the antenna of *nigricans* was figured by G. H. Horn (1887, p. 205, fig. 3) with the footnote by Horn saying "I have inserted this figure from a sketch made from LeConte's male type."

Brendel and Wickham (1890, p. 9, and p. 28-30) changed the name of Brendel's species to *triangulifer,* noting that *spinifer* was preoccupied. I have searched the works of Raffray (1903-04, 1908, 1911) and my card catalogue of Pselaphidae but find no *Batrisodes spinifer* by another author, and think that the change from *spinifer* to *triangulifer* was unnecessary. In this 1890 work the two figures by Brendel and the figure by Horn were used to separate *nigricans* and *triangulifer,* and Leng (1920), Bowman (1934), Leonard (1928) and others followed this taxonomy.

The male type of *nigricans* (LeConte) is mounted on an oblong card, and the head has been fractured, but fortunately the antennal structure is not destroyed. In fact, the damage to the specimen probably occurred after Horn made his unfortunate sketch, since the pendant lobe of the first antennal segment may be quite inconspicuous if the antenna is directed so that this lobe fits closely against the curving wall of the acetabulum.

Study of the *nigricans* type (MCZ 6171) demonstrates that (1) first antennal segment is deceptive, the long pendant lobe is a thin, tapering, arcuate plate. When the segment is seen in lateral view (P1 II, 11) the outline is flat and triangular; but when the segment is seen from a mesial view (VII, 5) only the sharp, thin triangular edge is obvious, and with low magnification and low illumination this pendant edge might be overlooked, probably the conditions that obtained when Horn saw it. (2) Antennal segment III is as described and figured in *nigricans,* but if the segment is not seen from a side view, the expanded depth is not obvious. Furthermore, the third antennal segment varies in this respect (Pl. II, 11 and Pl. VII, 5). (3) The tenth antennal segment is deeply foveate on the ventral face, not simple and unfoveated as noted by Brendel and Wickham (1890).

DISTRIBUTION

Published Records: Long Island, New York (Brendel, 1887; Brendel and Wickham, 1890; Leng, 1920; Bowman, 1934); Wyandanch, Suffolk County (type locality, in a sphagnum bog, *teste* C. W. Leng and A. S. Nicolay in Leonard, 1928), New York.

***Batrisodes denticollis* (Casey)**

Diagnosis: Male. Antennae with segment I with the ventral face produced ventrally as a rounded-triangular lobe (PL II, 10); X as wide as XI, with a fovea at basal third of ventral face.

Head with the median vertexal carina bisecting cervicum and cervical sulcus, but apt to be rudimentary on occiput and vertex; lateral vertexal carinae similarly poorly developed, and apt to be present only on temporal angles; antennal incisures and eyes prominent; vertexal foveae very large, deep and densely pubescent; circumambient sulcus tending to open on the front medianly. Front with a slightly declivous frontal margin between antennal articulations, this margin trilobed, the two lateral lobes large, the median lobe minute and apically setose; a pair of conspicuous, glabrous, conical teeth just below the minute median lobe. Front deeply excavated beneath the frontal margin, between antennal cavities.

Each elytron with three deep, nude basal foveae.

Last (fifth visible) sternite with a broad, transverse, median concavity from near apex to base.

Prothoracic legs with tarsal claw not bifid.

Mesothoracic legs with tarsi normal.

Metathoracic legs with tibia bearing a long, thick apical spur.

Female. Similar to male, except that the antennae are unmodified; circumambient sulcus entire; face strongly declivous between the prominent antennal tubercles, and not transversely excavated between antennal cavities; last sternite convex, with a small median basal concavity.

DISTRIBUTION

Published Records: Washington, District of Columbia (Casey, 1884; Bowman, 1934); Iowa and Virginia (Brendel and Wickham, 1890); Iowa, District of Columbia, New York and Illinois (Leng, 1920); New York (Leonard, 1928); Round Knob, North Carolina (Brimley, 1938).

Material Examined: Clayton, Rabun County, GEORGIA (O.P.); Dolson, and Urbana, Champaign County, ILLINOIS (O.P.); Baltimore, MARYLAND (O.P.); Palisades, Bergen County and South Orange, Essex County, *NEW* JERSEY (O.P.); Harrisburg, Dauphin County, PENNSYLVANIA (O.P.).

Iowa City and North Liberty, Johnson County, IOWA (FMNH); Washington, DISTRICT OF COLUMBIA (FMNH); St. Vincent, PENNSYLVANIA (FMNH); MISSOURI (CNHM).

Mayview, Champaign County and Astoria, Fulton County, ILLINOIS (INHS).

PENNSYLVANIA (MCZ); Alexandria and Gt. Falls, VIRGINIA (MCZ).

Both *nigricans* and *denticollis* have the first antennomere ventrally produced, but the lobe is quite different in the two populations. In *nigricans* it is thin, rather saucer-like, with a thin edge that is very acute in lateral view. In *denticollis* the lobe is much shorter, rounded-triangular and thicker. Furthermore, the third antennomere is perfectly simple in *denticollis*, but distinctly deeper than the adjacent segments in *nigricans.*

***Batrisodes schmitti* Casey**

Diagnosis: Male. Antennae abnormal. Segment I with ventral face inflated evenly to form an oblong with rounded corners, with the ventral face densely, finely setose (P1. II, 12); X as wide as Xl, with ventral face excavated and bearing a large, pubescent, eccentrically placed fovea at mesiobasal corner of excavation.

Head with a long median vertexal carina, from cervicum to center of vertex; lateral vertexal carinae entire, everted apically, from temporal angles to antennal incisures, so that the head appears wider through the antennal articulations than through the temporal angles; eyes prominent; vertexal foveae deep, pubescent; circumambient sulcus entire, strong, short. Front at first rapidly narrowed and slightly declivous between antennal articulations, then vertically declivous to a trilobed frontal margin. Median lobe of this margin slightly longer and opaque; lateral lobes wider, translucent. Median lobe bearing two pencils of ventrally-directed setae; lateral lobes each with a converging fringe of longer setae. Face deeply and transversely excavated beneath the overhanging frontal margin, between antennal cavities.

Each elytron with three deep, nude basal foveae.

Last (fifth visible) sternite relatively simple, with a small median concavity at base.

Metasternum with median, longitudinal sulcus deeper and broader apically to form a foveoid depression.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic legs with normal tarsi.

Metathoracic legs with tibia bearing an apical spur.

Female. Well-marked for the genus. Antennae unmodified. Front more strongly declivous between antennal articulations than in the male, then vertically declivous to clypeal margin. Clypeal margin apically directed in a wide, thin shelf, medianly pointed. Frontoclypeal declivity not transversely excavated or impressed between the antennal cavities, but bearing a median and two lateral dorsoventral carinoid ridges. Otherwise as for male.

DISTRIBUTION

Published Records: Westmoreland County, Pennsylvania (Casey, 1897; Bowman, 1934); Pennsylvania (Leng, 1920).

Material Examined: Type specimen from PENNSYLVANIA (USNM); NORTH CAROLINIA (O.P.); Spring Mill Park, INDIANA (INHS); Beatty, PENNSYLVANIA (MCZ).

Batrisodes striatus (LeConte)

This is another well-marked species of the *nigricans* group *(nigricans, denticollis, schmitti, striatus)* , and several synonyms of *striatus* are known:

1. simplex (LeConte), 1878, from Michigan, was based upon two immature females (Casey, 1893, p. 472).

2. aterrimus (Casey), 1884, from Massachusetts, was based upon the female sex (Casey, 1893, p. 472).

3. cephalotes (Casey), 1887, from New York (Casey, 1893, p. 472).

Diagnosis: Male. Antennae relatively simple; segment I with mesial face tending to be concave, with the concavity minutely granulated; III simple; X almost as wide as XI, with the ventral face not foveate.

Head with the median vertexal caring imperfectly developed to absent, at times represented on cervicum or occiput; lateral vertexal carinae similarly poorly developed to absent; eyes moderately prominent; vertexal foveae densely pubescent; circumambient sulcus poorly defined to wholly incomplete apically. Front broad and declivous between antennall articulations, then vertically declivous for a short distance, to form an overhanging frontal margin. Frontal margin bearing on each side a ventrally-directed, subtriangular fringe of converging setae; medianly the margin bears a variable number of subtriangular, recessed teeth. These recessed teeth are usually represented by a large median pair, but there is often a minute tooth laterad of each larger tooth, to give a quadridentate plate. Face deeply excavated transversely, beneath the overhanging frontal margin, between antennal cavities.

Each elytron with three nude basal foveae.

Last (fifth visible) sternite relatively simple and convex.

Prothoracic legs with primary tarsal claw not bifid.

Mesothoracic tarsi normal.

Metathoracic tibia with an apical spur.

Female. Antennae unmodified, with the usual relatively small tenth segment; face declivous and not transversely excavated; the circumambient sulcus poorly marked, but more complete. Otherwise as for the male sex.

DISTRIBUTION

Published Records: Pennsylvania (LeConte, 1850); Massachusetts to the Missouri river, north of the Ohio *(cephalotes* in Brendel and Wickham, 1890); Pennsylvania, Georgia, Massachusetts, Michigan, California (Leng,1920); New York (Leonard, 1928); east of the Mississippi river; California? (Bowman, 1934).

Material Examined: ONTARIO, CANADA (O.P.); Palos Park, Cook County, ILLINOIS (OP.); IOWA (O.P.); Rutherford, Bergen County and South Orange, Essex County, NEW JERSEY (O.P.) .

Bowmanville, Chicago and Palos Park, Cook County, and Antioch, Lake County, ILLINOIS (CNHM); Iowa City, Johnson County, IOWA (CNHM); Wallace, Wallace County, KANSAS (CNHM); Portsmouth, Newport County, RHODE ISLAND (CNHM).

ILLINOIS (INHS); Natick, Middlesex County, MASSACHUSETTS (INHS).

PENNSYLVANIA (MCZ type 6169); Ridgeway, ONTARIO, CANADA (MCZ); DISTRICT OF COLUMBIA; Springfield, Hampden County and Tyngsboro, Middlesex County, MASSACHUSETTS (MCZ); Rutherford, Bergen County and Arlington, Hudson County, NEW JERSEY (MCZ).

***Batrisodes tridens* Casey**

Diagnosis: Male. I do not know this species, and certain features have been selected from the published description.

First antennal segment large, strongly rounded beneath, compressed, with the mesial face bearing a large oval concavity, this cavity minutely granulatopunctate; X large, subglobose, slightly wider than XI, with the ventral face only slightly modified, bearing a small, rounded, subbasal areola or concavity.

Vertexal foveae nude; frontal margin bibbed, the sinus between the lobes bearing a short lamina that is apically tridentate; face excavated between the antennal cavities, beneath the overhanging frontal margin.

This species would appear to be near *striatus* (LeConte), but differs from the latter species in having nude vertexal foveae.

DISTRIBUTION

Published Records: St. Louis, Missouri (Casey, 1908; Bowman, 1934); Missouri (Leng, 1920).

***Batrisodes kahli* Bowman**

Diagnosis: Male. I do not know this species, and have selected certain features from the published description.

Antennal segment X transversely globose, slightly wider than XI, with the ventral face simple, not bearing a fovea.

Vertexal foveae nude, broad and shallow; circumambient sulcus broad, shallow and entire; integument external to this sulcus densely and coarsely punctate, but surface enclosed by sulcus smooth; overhanging frontal margin bearing a pair of small, rounded tubercles near middle, and a larger acute spine near each lateral corner of the margin; face transversely excavated between antennal cavities, beneath overhanging frontal margin.

Posterior tibiae each with an apical spur.

This species is said to be most comparable to *clypeonotus* (Brendel), from which it is distinct in having the first antennal segment short, stout and uniformly punctate.

DISTRIBUTION

Published Records: Tennessee (Bowman, 1934).

***Batrisodes caseyi* Blatchley**

Diagnosis: Male. I do not know this species. It may be coincidence, but specimens bearing the name of this species, and submitted to me for identification, have all been *ionae* (LeConte).

It is described as of a uniform reddish to chestnut brown, with sparse, stiff, suberect yellowish pubescence. The head is large, as wide as pronotum, with a strongly swollen and uncarinated vertex. Vertexal foveae very small. Antennae short and stout, with segments II to X inclusive wider than long, and XI oblong oval and almost as long as the three preceding segments. Pronotum as wide as long, with a deep median sulcus that is apically abbreviated, and with deep subbasal pronotal foveae. Elytra smooth, convex, with humeri not prominent. 2.5 mm. long.

Desiderata are data on number of basal elytral foveae per elytron, structure of distal antennal segment, and structure of the mesothoracic femora.

DISTRIBUTION

Published Records: Posey County, Indiana and Kentucky, opposite Cincinnati, Ohio (Blatchley, 1910); Ohio and Indiana (Leng, 1920); Cincinnati, Hamilton County, Ohio; Posey County, Indiana; Covington, Kenton County, Kentucky (Bowman, 1934).

DESCRIPTION AND INTEGRATION OF NEW SPECIES

***Batrisodes sandersoni* new species**

Type. Head 0.33 mm. long x 0.45 mm. wide; cervicum 0.7 mm. long; pronotum 0.45 mm. x 0.45 mm.; elytra 0.56 mm. x 0.67 mm.; abdomen 0.6 mm. x 0.67 mm.; total length, with head extended so that cervicum is not counted, 1.9 mm.

Reddish-brown, with paler palpi and legs. Pubescence rather coarse, long, semiappressed and golden.

Head with rudimentary eyes of about 12 facets each, typical of females of the *monstrosus* group; supraocular carina present; lateral vertexal carina present from temporal angle to antennal incisure; occiput with three apically converging carinae, a median longimdinal and a right and a left oblique, as in *monstrosus*, *armiger* and *cavicrus;* the median carina subserrate and extending from a point between, and anterior to, the vertexal foveae, to the pronotum; vertexal foveae deep and nude; circumambient sulcus entire; front dorsally concave between antennal tubercles, then vertically declivous; frontoclypeus not transversely excavated, but bisected by a dorsoventral carina from the arcuate interantennal line to the center of the clypeal margin; clypeal margin developed at right angles to clypeus, as a thin shelf, the clypeal margin evenly rounded when seen from above; labrum broadly arcuate; maxillary palpi and genal beard as for genus; antennae simple and unmodified, as in *cavicrus.*

Pronotum with a median and a right and a left subbasal fovea of nearly equal size; median fovea connected to basal bead by a longitudinal carina; disc rather flat, bisected by a very feeble sulcus that extends from median fovea to apical fifth; lateral longitudinal sulcus very weakly developed from each lateral fovea; lateral discal carina, between median and lateral sulci on each side, represented by a low conical tumulus, between lateral and median fovea, and apically by two strong, recurved teeth on disc. Lateral pronotal margin each side bearing an acute spine directed dorsoposteriorly (Pl. VI, 3), as in *carolinae.*

Each elytron with sloping humeral angle armed with a small tooth; flank with the usual nude subhumeral fovea and longitudinal sulcus; base with three deep, nude foveae; the sutural fovea at origin of entire sutural stria, and this fovea close to discal fovea, so that the two lie in a sutural impression; humeral fovea distant from these two foveae, at origin of a rather deep longitudinal impression that extends to middle of elytral length; surface between these two impressions narrow and linear, appearing like a discal costa.

Abdomen with margins lacking, and marginal carinae as in the genus; five visible tergites; first tergite with a pair of median basal carinae, these carinae one-fourth as long as segment, and separated at their tips by one-fifth of the entire segmental width; five sternites completely visible from side to side, and another sternite, largely obscured by coarse pubescence, discernible between mesial angles of metacoxae; last sternite as long as the first completely visible sternite, with a basally deepening, semicircular impression in basal half.

Legs simple and unmodified, with normal tarsi and the metathoracic tibiae lacking apical spurs.

Described on one female, the type specimen, collected by Herbert H. Ross and Milton W. Sanderson at Herod, Pope County, Illinois on April 15, 1944; named for Dr. Sanderson, type deposited at the Illinois Natural History Survey.

This species is rapidly discriminated from its allies. It is a member of the *monstrosus* group, and has the tricarinate occiput of *cavicrus*, and the spined pronotal margin of *carolinae;* no other species of the group has this combination of characters.

The *monstrosus* group is sharply set off from all other groups of *Batrisodes* in the Nearctic Region by the complete absence of tibial spurs. This group, so far, is not known beyond the limits of the deciduous forest biome of North America.

At present it consists of six species. The female sex has rudimentary, inconspicuous eyes of six to fourteen facets; the male sex has large, prominent eyes of forty or more facets.

The aedeagus of *Batrisodes* is highly specialized, with notable reduction of parts, and a developing bilateral asymmetry. Among species studied so far, this tendency apparently culminates in *monstrosus*. Whereas the aedeagus is bilaterally symmetrical in *furcatus* and *riparius*, and progressively asymmetrical in *globosus, denticollis* and *schaumi*, this organ becomes not only very asymmetrical in *monstrosus*, but develops a movable accessory piece (Park, 1942, p. 15-17, Pl. I, fig. 11-14, P1. II, fig. 1-5). The aedeagus of *monstrosus* is so far removed from that of other *Batrisodes* studied, that it should serve to separate this group as a subgenus, if further research demonstrates that the other allied species have male genital apparatus of the general *monstrosus* type.

Contrary to older accounts, all species of this group have three basal elytral foveae on each elytron, the sutural fovea set close to the suture and often overlooked.

Males are strongly modified. In *monstrosus* and *armiger* the tenth antennal segment is excavated; *armiger* has the eleventh antennal segment spined; prothoracic tibia medianly toothed in *monstrosus* and *armiger*, and the mesothoracic femur deeply notched in these two species; the metathoracic trochanters are spined in *monstrosus, armiger, confinis, cavicrus*, and *carolinae; armiger* has the second segment of the metathoracic tarsus greatly swollen.

The following key integrates *sandersoni* with other members of the group, in so far as the known sexes permit.

KEY TO BOTH SEXES OF THE SPECIES OF THE MONSTROSUS GROUP

1 Eyes rudimentary, consisting of from 6 to 14 facets (FEMALES) 2
Eyes normal and prominent, consisting of 40 or more facets (MALES) 5

2 (1) Occiput with three apically converging carinae: a median, and a right and a left oblique carina 3
Occiput with only a median longitudinal carina *confinis* (LeConte).

3 (2) Lateral pronotal margin bearing a posteriorly-directed spine on each side (P1. VI, 3); only female known *sandersoni* new species.
Lateral pronotal margin lacking this spine (Pl. VI, 4) 4

4 (3) Relatively large, 2.4 to 2.6 mm. long *monstrosus* (LeConte).
Relatively small, 1.7 to 2.0 mm. long *cavicrus* Casey.

5 (1) Occiput with three apically converging carinae: a median, and a right and a left oblique carina 6
Occiput with only a median longitudinal carina; only male known *carolinae Casey*.

6 (5) Prothoracic tibia with a conspicuous tooth or tumulus near center of dorsal face 7
Prothoracic tibia lacking this tooth *cavicrus* Casey.

7 (6) Second tarsomere of metathoracic tarsus greatly swollen, ovate, as wide or wider than tibial apex; only male known *armiger* (LeConte).
Second tarsomere of metathoracic tarsus simple, compressed-cylindrical, much narrower than tibial apex *monstrosus* (LeConte).

***Batrisodes rossi* new species**

Type. Head 0.42 mm. long x 0.42 mm. wide; pronotum 0.42 mm. x 0.42 mm.; elytra 0.60 mm. x 0.67 mm.; abdomen 0.60 mm. x 0.56 mm.; total length 2.0 mm.

Light reddish-brown with paler appendages. Pubescence long, semi-erect and flavous.

Head with eyes moderately prominent, of more than forty facets; no supraocular carina; lateral vertexal carinae entire, subparallel from temporal angles to antennal incisures; median vertexal carina long, entire from apical pronotal margin to center of vertex between the foveae; vertexal foveae deep, nude; circumambient sulcus deep in front of each fovea, becoming shallow anteriorly, and very difficult to trace at its apical margin where the sulcus becomes obscured by the frontal sculpture; inter-foveal integument strongly shining and subimpunctate, clothed with a few long erect setae that converge apically to arch over the interfoveal center; front gently convex between antennal incisures, then gently declivous between antennal articulations; this frontal declivity progressively narrowed apically, to form a blackened, overhanging frontal margin; frontal margin medianly transversely sinuate, the external angles of the sinuation triangular; frontal declivity slightly concave laterally and convex medianly, entirely granular and setose; face simply and transversely excavated beneath frontal margin, between antennal cavities, the excavation simple and setose; clypeus rather simple, no definite clypeal margin present, the apical outline, from above, narrowly rounded, the apical portion longitudinally thickened and visible between the angles of the frontal sinuation, but with no erect clypeal tubercle or other modification.

Antennae with first segment simple, elongate; II to VII narrower than first, elongate; VIII quadrate; II to VIII subequal in width; IX as wide as first, transverse; X much larger, one and a half times the width of first, subspherical, with a small perforate fovea on ventral face at basal seventh (Pl. VI, 2); XI wider than tenth, as long as preceding three segments united, ventral face simple, subconvex, and not spined.

Pronotum with reduced sculpture; median sulcus and lateral sulci rudimentary, shallow and not extending beyond median third of total pronotal length; median and lateral subbasal foveae subequal in size, the median connected to basal bead by a longitudinal carina; lateral discal carinae rudimentary, each extended forward a short distance from an acute, low subbasal tumulus; lateral pronotal outlines simple and unspined.

Each elytron with humeral angle oblique, smooth and unarmed; flank with the usual subhumeral fovea and longitudinal sulcus of the genus; three deep, nude basal foveae; sutural stria entire; discal impression very short, weak and subbasal in extent.

Last sternite simply convex.

Metasternum medianly flattened, the flattened area longitudinally sulcate, the sulcus deepened apically into a fovea between the mesial angles of the metathoracic coxae.

Prothoracic legs simple, primary tarsal claw not bifid.

Mesothoracic legs with very abnormal tarsi of the *punctifrons* type (Pl. III, 12) , the second segment sinuate above and deeply notched below.

Metathoracic legs with the tibia bearing a long apical spur.

Described on one male, the type specimen, collected by Herbert H. Ross and Milton W. Sanderson at Herod, Pope County, Illinois on April 18, 1944; named for Dr. Ross; type deposited at the Illinois Natural History Survey.

This species is a member of the *punctifrons* group. It may be differentiated from *punctifrons* and *appalachianus* by the structure of the face, and the antennal club. These two species have the tenth antennal segment relatively small, similar to the ninth segment in form but normally larger, and with the ventral face not foveate; the eleventh segment is relatively very large. In *rossi* the tenth antennal segment is relatively large, sub-spherical and foveate beneath; the eleventh segment is of normal size.

***Batrisodes hairstorii* new species**

Type. Head 0.45 mm. long x 0.47 mm. wide through eyes; pronotum 0.45 x 0.42 mm.; elytra 0.60 mm. x 0.67 mm.; abdomen 0.56 mm. x 0.67 mm.; total length 2.06 mm.

Reddish-brown with paler palpi and legs. Pubescence moderately long, semiappressed, flavous.

Head with prominent, rounded eyes of about 48 facets; supraocular carinae absent; lateral vertexal carinae strong, entire from temporal angle to a point just behind antennal incisures, slightly everted in apical half to approach the condition in *schmitti;* median vertexal carina strong over cervicum and cervical sulcus, and weakly developed over occiput, ending at a line through posterior margins of vertexal foveae; vertexal

foveae deep, nude; circumambient sulcus v-shaped, incomplete apically but deep from each fovea; interfoveal surface subimpunctate; front declivous on a line through antennal articulations, extending apically to a broad frontal margin; frontal margin, when seen from above, undulated, when seen directly, transverse with rounded corners and a small median lobe; frontal declivity set with sparse, coarse, shallow punctures and sparse, apicoventrally directed setae; front transversely excavated beneath the overhanging frontal margin, between antennal cavities, the excavation simple and densely setose; clypeus simple, medianly thicker to form a blunt, setose swelling, and with a broadly ogival apical margin.

Antennae with basal segment simple and elongate; II to VII subequal in width, slightly elongate; VIII subquadrate; IX asymmetrically transverse, the mesial face much shorter than lateral face; X abnormal, very slightly narrower than eleventh, slightly transverse, subcircular from a dorsal view, ventral face asymmetrical, strongly flattened, bearing a large, setose, eccentric fovea over half of surface (Pl. VI, 5); XI abnormal, only slightly wider than tenth but as long as three preceding segments united, ventral face with the longitudinal convexity strongly angulated at middle, the basal half of the convexity flattened obliquely, with a minute tooth set near base (Pl. VI, 5).

Pronotum with sculpture greatly reduced; the median and right and left lateral sulci evanescent, not reaching disc; the median and right and left lateral subbasal foveae subequal in size; the interposed right and left lateral subbasal tumuli and longitudinal carinae rudimentary; median subbasal fovea connected to basal bead by an exceptionally strong longitudinal carina.

Elytra, metasternum, and last sternite as described for *rossi.*

Prothoracic legs with primary tarsal claw not bifid.

Mesothorocic legs with very abnormal tarsi, as in *cavicornis* and *punctifrons* (Pl. III, 6, 12).

Metathoracic legs with the tibia bearing a long apical spur.

Described on one male, the type specimen, taken on May 1, 1947, from the stomach of a red-backed salamander, *Plethodon cinereus cinereus* (Green), under a rotting log in the Clark County State Park, near Uno, Indiana, about thirteen miles north of the Ohio River. Named for Nelson G. Hairston, of the Department of Zoology, Northwestern University, under whose direction the salamander was collected. Stomach analysis was made by the author.

This new species is especially notable as a consequence of the ecological record. The food of adult pselaphids is known. They are predaceous, and this has been known since 1825, when Henry Denny noted that

British species fed upon mites in damp situations. Their mite-devouring proclivities have been checked by subsequent observations, both in the field and in laboratory (Park, 1942, 1947) . In addition to mites, pselaphids are known to feed upon a variety of other foods, including earthworms, small flies, and dead ant larvae, living ant larvae, and ant eggs (Park, 1932a, b, 1933).

By contrast, no definite information was at hand as to the enemies of pselaphids. Consequently this is the first record of predation, and serves, in small measure, to extend the food-chain.

When the amphibian's stomach was opened, the contents were found to consist of several ants *(Aphaenogaster* sp.), several of the large gamasid mites often taken in the nests of such ants, and the specimen of *Batrisodes hairstoni.* Since *Aphaenogaster* is common in log mold, and is known to be the host of several species of *Batrisodes* (Park, 1935), it seems safe to assume that the salamander was feeding upon an *Aphaenogaster* colony, and ate the beetle and mites as well.

This assumption is tenable if *hairstoni* is an inquiline, and it must not be forgotten that another alternative is available, namely that *hairstoni* may not be inquilinous, and that the salamander ate it in the log mold, independently of the ants.

Fortunately the salamander was killed, and its stomach injected with alcohol, before digestive action had damaged the contents. The beetle, ants and mites were in perfect condition.

Furthermore, there is nothing unusual about the salamander eating these arthropods. In a recent study of the food of *Plethodon cinereus,* Jameson (1944) reported upon the contents of 169 stomachs. Insects composed 73 per cent of the total contents, beetles formed 20 per cent of total, and ants 4 per cent. Therefore, not only is *Plethodon cinereus* known to have eaten a pselaphid, but salamanders, toads and wood frogs may be assumed to be natural enemies of these beetles as a general consequence of the record cited, and the general food-habits of these amphibians.

The type of *hairstoni* is in the author's collection. This species is allied to those *Batrisodes* having the mesothoracic tarsi abnormal: *riparius, uncicornis, antennatus, foveicornis, cavicornis, punctifrons, appalachianus,* and *rossi.*

Of this group *punctifrons* and *appalachianus* can be separated from *hairstoni* by the tenth antennal segment lacking a fovea, and from *rossi* by the very minute fovea of the tenth antennal segment.

Of the remaining five, *foveicornis* and *cavicornis* are quickly separable since they have a very shallow, transverse frontal impression; *riparius* and *uncicornis* have the eleventh antennal segment prominently spined; *antennatus* has a qualitatively different antennal club (Pl. II, 9).

***Batrisodes shaefferi* new species**

Holotype male. Head 0.37 mm. long x 0.42 mm. wide; pronotum 0.37 mm. x 0.37 mm.; elytra 0.53 mm. x 0.60 mm., abdomen 0.53 mm. x 0.60 mm.; total length 1.80 mm.

Dark reddish-brown with paler appendages; pubescence moderately long, semierect and flavous. Integuments very finely alutaceous.

Head with moderately prominent eyes of about 44 facets; supraocular carina absent; lateral vertexal carinae present from temporal angle to antennal incisure, each side; median vertexal carina absent on vertex, and only weakly formed over cervicum; vertexal foveae deep and nude; circumambient sulcus not entire, sharply interrupted apically; front gently declivous from a line through antennal articulations; the short frontal declivity set with rather large, sparse, shallow punctures, the declivity narrowing anteriorly between antennae to a transverse margin; frontal margin blackened, granulated, and simple, not provided with any teeth; front transversely excavated beneath the overhanging frontal margin, between antennal cavities, the excavation simple, not provided with teeth, but densely setose; clypeus seen from above with a semicircular apical margin, and medianly erected into a clypeal tubercle; this clypeal tubercle conical and erect, setose.

Antennae with the basal segment elongate, the mesial face flattened and minutely granulated, with the ventral outline arcuate; II and III elongate; V and VII slightly larger than IV, VI, or VIII; IX as wide as first, transverse, with the ventral face much shorter than dorsal face; X large, subspherical, as wide as eleventh, with a minute fovea on basal five-sixths of ventral face; XI equal to tenth in width, of normal shape with a convex ventral face, as long as preceding three segments united.

Pronotum with the rudimentary sculpture as described for *hairstoni*, except that the longitudinal carina connecting the basal bead with the median subbasal fovea is incomplete, and does not reach the fovea. Elytra, metasternum and last sternite as in *hairstoni.*

Prothoracic legs with the femur bearing a well-developed pad of short, oblique, dense setae at base of ventral face near trochanter; primary tarsal claw not bifid.

Mesothoracic legs with the trochanter bearing a short, aciculate spine at. apex of ventral face; tarsi relatively normal, the ventral face of second segment slightly sinuate (Pl. VI, 6) .

Metathoracic legs with tibia bearing a strong apical spur.

Allotype female. Similar to male, except that the entire face is declivous, not transversely impressed or excavated, not bearing a median dorsoventral carina, clypeus densely and finely granulato-punctate, the

clypeal margin slightly reflexed, thin and broadly ogival seen from above; antennae with basal segment with a convex ventral outline and slightly granulated, but mesial face not flattened, segment X of relatively normal proportions and with the ventral face not foveate; prothoracic femur not bearing a setose pad; mesothoracic trochanter not bearing a spine oz tooth, and the tarsi perfectly normal.

Described on one pair, holotype male and allotype female, in the author's collection. These two specimens were in the original Charles Schaeffer collection, and bore the notation "*Batrisodes* n.sp." After examination had confirmed that they represented a species that was undescribed, it was a pleasure to name the new species for their late owner.

The label gave the locality as North Carolina, without further data.

***Batrisodes striatus psotai* new variety**

Type. Similar to *striatus* (LeConte), except that the ventral face of the tenth antennal segment bears a large, glabrous foveoid depression.

Described on a male specimen, collected by F. Psota on May 8, 1930 at Antioch, Lake County, Illinois, deposited in the Chicago Natural History Museum.

Batrisodes striatus is a variable species, and one of the labile features is the ventral surface of the tenth antennal segment. In a long series of specimens, from many localities within the range of the population, the ventral face of this segment has been found to vary. The ventral face may be perfectly convex; it may bear a subcircular flattened surface; it may bear a very shallow, subcircular depression; the rim of such a depression may be higher on one side than the other; an extreme condition, described in *psotsi*, shows the depression as a deeper, foveoid concavity. In no case is a true, perforate, deep fovea developed with rim setae. Consequently, if such extreme variations are taken through the key on the assumption that the depressions are foveae, the specimens would diverge from all known North American species of *Batrisodes* and unjustified confusion would result.

The *nigricans* group is a compact assemblage of species, all having pubescent vertexal foveae and a common habitus. The females are less easily separated than are the males. The following partial key integrates the new variety, and may serve a useful subsidiary purpose.

KEY TO THE SPECIES OF THE NIGRICANS GROUP

1. Face transversely excavated between the antennal cavities (MALES) 2
   Face simply declivous from interantennal line to clypeal margin, not transversely excavated (FEMALES) ó

2 (1) Antennomere I with the ventral face produced ventrally as a glabrous triangular spine or pendant lobe 3
Antennomere I with ventral face not as described 4

3 (2) Antennomere III slightly longer than either II or IV, and the ventromesial face slightly to strongly swollen *nigricans* (LeConte).
Antennomere III simple, slightly shorter than II *denticollis* (Casey).

4 (2) Antennomere I with ventral face uniformly inflated and flattened to form a rounded-oblong, densely, minutely setose (P1.11,12); ventral margin of overhanging front developed into a small, rounded-triangular lobe *schmitti* Casey.
Antennomere I with ventral face normally convex; ventral margin of overhanging front developed into a pair of blunted, rounded-triangular teeth 5

5 (4) Ventral face of antennomere X bearing a subcircular, glabrous, foveoid depression *striatus psotai* new variety.
Ventral face of antennomere X evenly convex or flattened *striatus* (LeConte).

6 (1) Antennomere III slightly longer than II *nigricans* (LeConte).
Antennomere III distinctly shorter than II 7

7 (6) Facial declivity bisected by a median dorsoventral carina or carinoid ridge *schmitti* Casey.
Facial declivity lacking this ridge 8

8 (7) Top of head distinctly and rather suddenly narrowed on a line passing just apical to anterior eye margins; apical clypeal margin tending to be medianly reflected or elevated *denticollis* (Casey).
Top of head subquadrate in outline, the narrowing just apical of eyes much more gradual and slight; apical clypeal margin tending to be simple, and not medianly elevated or reflected *striatus* (LeConte).

Species of nearctic *Batrisodes* are divisible into a number of groups. Considerable study of possible groupings, based on the aedeagus where feasible, secondary sexual modifications, general habitus and other features, led to the separation of as many as twenty-two groups and as few as nine groups. Not all of the groups are of equal rank. For example, the *monstrosus* group could be separated as a subgenus on the basis of the bilaterally asymmetrical aedeagus with its associated accessory piece (Park, 1942) and the absence of spurs on the posterior tibiae. More investigation is needed before such a course could be adopted. Again, several groups have a pronounced habitus that quickly separates each of them.

This is especially notable for the *monstrosus, scabriceps, lineaticollis,* and *nigricans* groups. In other examples, such as the *riparius* group, a number of apparently very dissimilar species are united in the possession of very abnormal tarsi on the intermediate legs of the males. The subject of groupings within the genus will be dealt with later, in a paper covering the western species of the genus. For the present, the following group key, and list of group compositions will serve to denote some progress

Two species have not been allocated to any group. *Batrisodes tridens* Casey has affinity with the *nigricans* group but lacks pubescent vertexal foveae; *Batrisodes schaefferi* new species has affinity with some species of the complex *riparius* group but serves to connect this latter assemblage with the other nearctic species by having the male mesotarsi only slightly abnormal.

KEY TO A TENTATIVE GROUPING OF NEARCTIC BATRISODES

1 Posterior tibiae lacking apical spurs (Pl. III, 3)
I. MONSTROSUS GROUP.

Posterior tibiae each with an apical spur (P. III, 1, 2) 2

2 (1) Males with the mesothoracic tarsi abnormal (P1. III, 6)
IX. RIPARIUS GROUP.

Males with the mesothoracic tarsi normal (Pl. III, 5) 3

3 (2) Vertexal foveae pubescent VIII. NIGRICANS GROUP.

Vertexal foveae nude 4

4 (3) Males with face transversely excavated between the antennal cavities (P1. I, 1) 7

Males with face not transversely excavated between the antennal cavities (Pl. I, 3) 5

5 (4) Species not found west of the Great Plains 6

Species not found east of the Rocky Mountains
II. ALBIONICUS GROUP.

6 (5) Males with mesothoracic femur bearing a conspicuous, arcuate, blunted spine on ventral face (Pl. III, 3) III. IONAE GROUP.

Males with no mesothracic femoral spines
VII. LINEATICOLLIS GROUP.

7 (4) Males with the front produced between the basal segments of antennae as a long, ogival arc (P1. IV, 1) V. FRONTALIS GROUP.
Males with the front not produced in this way, but usually diversely modified 8

8 (7) Males with the scabroid frontal declivity bearing a conspicuous, glabrous, semicircular excavation on which are placed two pairs of minute tubercles (P1, VII, 2, 3) IV. SCABRICEPS GROUP.
Males with frontal declivity not so organized, but usually with a distinct pair of teeth on the overhanging frontal margin (Pl. IV, 2) VI. FURCATUS GROUP.

TENTATIVE GROUP ALLOCATONS OF NEARCTIC BATRISODES

I	II	III	IV	V
armiger	*albionicus*	*? caseyi*	*scabriceps*	*beyeri*
carolinae	*aphaenogastri*	*ionae*	*temporalis*	*frontalis*
cavicrus	*cicatricosus*	*schaumi*		*globosus*
confinis	*denticauda*			
monstrosus	*lustrans*			
sandersoni	*mendocino*			
	monticola			
	occiduus			
	pygidialis			
	speculum			
	tulareanus			
	zephyrinus			

VI	VII	VIII	IX	Unallocated
furcatus	*bistriatus*	*denticollis*	*antennatus*	*schaefferi*
sinuatifrons	*cartwrighti*	*nigricans*	*appalachianus*	*tridens*
—	*declivis*	*schmitti*	*cavicornis*	
? clypeonotus	*fossicauda*	*striatus*	*foveicornis*	
? kahli	*lineaticollis*		*hairstoni*	
? luculentus			*punctifrons*	
? virginiae			*riparius*	
			rossi	
			spretus	
			uncicornis	

GENERAL ECOLOGY OF THE GENUS

There is notably even less information available on the ecology of *Batrisodes* than there is on the taxonomy of the genus. Futhermore, most of these data refer to the most abundant and best known species, *globosus.*

Habitat. In common with pselaphids in general (Park, 1942, 1947), the species of *Batrisodes* inhabit two chief types of habitats. These are the moist, dark, organic debris of leaf and log mold on the floors of rich forests, and the nests of ants. In addition to forests and ant societies, the genus is found in several less frequented habitats.

For example, they may be sifted from dried grass and weeds along the margins of meadows *(striatus);* certain species have been taken in the nests of the termite *Reticulitermes flavipes,* especially *spretus* (Blatchley, 1910, p. 327); and other species are cavernicolus. [10]

The forest habitat may be considered as the primitive or historical home of the genus. Many species live in the leaf debris and mold on the forest floor, in decayed log mold, beneath loosened bark, and in the discontinuous extensions of the forest floor, the tree-holes.

As will be seen presently, the general behavior of species of *Batrisodes* to relatively low light intensities and relatively high concentrations of moisture, together with their nocturnalism, tend to restrict the populations to dim, moist forest mold or to place a positive selection value upon such habitats (Park, 1947).

It is not surprising, therefore, that the species have entered, and become adjusted to, the dark, moist, well-stocked societies of ants in the course of their evolution.

Within a given area, certain species are found almost exclusively in floor mold, others are found almost exclusively in ant nests *(monstrosus),* whereas others *(globosus)* are facultative in this respect, and may be taken both in floor duff and in the ant society (Park, 1942). In such cases, other things being equal, the species that are the constant guests of ants are to be considered more highly evolved or specialized, than are the facultative mold/nest dwellers. Such an assumption rests on general evolutionary grounds rather than upon particular morphological detail, since the litter is assumed to be a more ancient home than the ant society.

Finally, as will be suggested later in a discussion of the LeConte Hypothesis, latitude may bear upon the problem of habitat tolerance.

Turning more especially to the ant society, those species of *Batrisodes* that live wholly or partially with ants are integrated in this amazonian

[10] These cavernicolous species of *Batrisodes* are not taken up in the present paper. They form a portion of a new and spectacular pselaphid fauna of Alabama caves. These species were collected by Dr. W. B. Jones and others (Löding, 1945, p. 42), and were sent to me for analysis by Dr. J. M. Valentine. This study is in process, and the results will be communicated elsewhere.

pattern in the rôle of synoeketes. That is, they are inhabitants of the nest and, as such, are not actively persecuted by the host, and are usually indifferently tolerated. See Wasmann (1894), Wheeler (1910, 1923), Park (1942, 1935b).

The details of occurrence of the genus with ants, in the area under discussion, are summarized in the following table.

TABLE I

RECORDS OF BATRISODES FOUND WITH ANTS

Species	Host	Source of data
aphaenogastri	*Aphaenogaster occidentalis*	Fall, 1912
bistriatus	*Formica exsectoides*	Amagansett, Suffolk Co., New York 21.IX.10. W. T. Davis
fossicauda	*Formica exsectoides*	Wickham, 1900
	Formica subsericea	Wickham, 1900
foveicornis	*Lasius aphidicola*	Wickham, 1896
frontalis	*Lasius claviger*	Wickham, 1898
	Lasius americanus	Wickham, 1900
	Lasius aphidicola	Park, 1935a
	Lasius aphidicola	Urbana, Champaign Co., Illinois 22.V.34. O. Park
globosus	*Camponotus pennsylvanicus*	Schwarz, 1890
	Lasius americanus	Schwarz, 1890
	Camponotus herculeanus	Wickham, 1898
	Lasius americanus	Wickham, 1900
	Lasius aphidicola	Wickham, 1900
	? Formica ulkei or *exsectoides*	Blatchley, 1910
	With ants, host not specified	Leng and Nicolay, in Leonard, 1928
	Formica ulkei	Holmquist, 1928
	Formica ulkei	Park, 1929
	Lasius americanus	Park, 1932
	Lasius americanus	Park, 1935a
	Formica ulkei	Park, 1935b
	Formica subsericea	Park, 1935a
	Camponotus noveboracensis	Park, 1935a
	Lasius americanus	Springfield, Sangamon Co., Illinois 25.IV.26. O. Park
	Lasius americanus	Madison, Dane Co., Wisconsin 26.V.29. O. Park
	Camponotus noveboracensis	Cambridge, Dane Co., Wisconsin 26.V.29. O. PARK
	Lasius aphidicola	Yorkville, Kendall Co., Illinois 28.IV.42. O. Park

Species	Host	Source of data
globosus	*Lasius americanus*	Wheaton, DuPage Co., Illinois 16.V.42. O. Park
	? Lasius aphidicola	Tremont, Porter Co., Indiana 21.V.47. E. Ray
	Lasius aphidicola	Tremont, Porter Co., Indiana 21.V.47. Patricia Park
	Camponotus noveboracensis	Tremont, Porter Co., Indiana 21.V.47. O. Park
	Lasius aphidicola	Lakeside, Berrien Co., Michigan 16.VIII.47. L. Jones
ionae	*Lasius americanus*	Schwarz, 1890
lineaticollis	*Formica subsericea*	Wickham, 1894
monstrosus	*Lasius claviger*	Schwarz, 1890
	Lasius interjectus	Schwarz, 1890
	Amblyopone serrata	Schwarz, 1890
	With ants, host not specified	Blatchley, 1910
	With ants, host not specified	Leng and Nicolay, in Leonard, 1928
	Lasius aphidicola	Park, 1935a
	Lasius aphidicola	Urbana, Champaign Co., Illinois 22.V.34. O. Park
	Lasius aphidicola	Crothersville, Jackson Co., Indiana 20.IV.35. O. Park
	? Lasius aphidicola	Plummers Id., Maryland 1.V.14.
riparius	*Aphaenogaster tennesseensis*	Park, 1935a
scabriceps	*Formica subsericea*	Wickham, 1896
	Formica exsectoides	Leng and Nicolay, in Leonard, 1928
	Aphaenogaster tennesseensis	Park, 1935a
	Aphaenogaster fulva	Urbana, Champaign Co., Illinois 22.V.34. O. Park
schaumi	*Lasius aphidicola*	Park, 1935a
	Aphaenogaster tennesseensis	Park, 1935a
zephyrinus	*Formica rufa*	Mann, 1911

Of special interest in this table is the fact that of the forty-one species of *Batrisodes* east of the Rocky Mountains, twelve, or twenty-nine per cent, are known to be associated with ants to some extent.

The most abundant, and most widely distributed species *(globosus)* is recorded with the largest number of known hosts.

Of the latter, the light-yellow species and subspecies of *Lasius* (e.g. *umbratus mixtus aphidicola* and allies) have societies that are either most easily penetrated, or are the most stimulating to *Batrisodes.* Such ants have populous colonies, of a pleasing aromatic odor, generally tend

aphids, and excavate soft, decayed logs on the floors of deciduous forest communities. *Lasius niger americanus* is even more widely distributed, frequently tends aphids, and is another common host. The large colonies of the mound-builders *(Formica exsectoides* and *ulkei)* are apparently less easily penetrated, possibly as a consequence of their larger worker size and more obvious ability to defend the nest.

Despite this defense, such mound-builders have quite an array of inquilines, of several categories of ecological association (Park, 1929, 1935b), but do not appear to harbor many species of *Batrisodes.*

Aphaenogaster fulva, in well-decayed logs, and *A. tennesseensis,* usually in harder wood, may have extensive colonies and are the hosts of at least three species of *Batrisodes.*

The percentage of occurrence of these pselaphids with ants indicates a definite myrmecophilous potential of the genus, in the area under discussion. More intensive collecting should serve to strengthen, rather than detract from, this assertion. With this in mind, an examination of the small amount of data on the requirements and behavior of the genus is desirable.

Food. The species of *Batrisodes,* as far as is known, are carnivorous. Within this category, the beetles exhibit a variety of response: cannibalism, predatism, and scavengerism.

Under natural conditions, the facultative *globosus* has been observed, under a hand lens, feeding upon mold mites of the families Hoplodermatidae and Oribatidae (Pl. VIII). This mite-devouring proclivity is fairly general for the family (Park, 1947). Denny (1825) gave the food of British pselaphids as mites, in moist habitats. In laboratory containers the same activity may be observed under higher magnification.

Batrisodes globosus also attacks earthworms (Park, 1929). When this species is isolated with earthworms in artificial nests, the beetles bite at the worm's integument, and eat the secreted slime. They bite and gnaw the wounds, and scrape up exuded body fluids avidly. The prothoracic tarsi are planted on the worm, the mandibles bite into the tissues, and the head is pulled upwards while the legs are braced against the writhing worm.

If entangled in the mucus, the beetles eventually free themselves by extricating one tarsus after another.

The twisting of the worm does not deter the beetles, and as many as three *globosus* per square centimeter of worm surface have been noted feeding under laboratory conditions. Nevertheless, if one of the beetles comes too close to another under these circumstances, it will pause in feeding long enough to bite at the intruder, and usually drives the latter away.

This species may feed on earthworms for as long as thirty minutes. After feeding the beetles clean their antennae and forelegs. Usually one antenna at a time is thrust from above between the slightly gaping mandibles. Then it is pushed and pulled back and forth, in part by its own muscles, but also by the forelegs which may assist in pushing the antenna upward. After the antennae have been cleaned they are with drawn and each prothoracic leg is thrust between the mandibles in turn, where it is drawn rapidly back and forth, as far as the basal third of the tibia.

After such cleaning behavior they may return to eating, or not.

In addition to mold mites and earthworms, *globosus* will attack members of its own species. This cannibalism can be forced upon them if several beetles are isolated in a moist petri dish without food. Under these circumstances, the first individual to weaken and die is attacked by the others. These latter bite and scrape the integuments, especially the relatively thin articular membranes.

These few data suggest that members of this genus, when not in the nests of ants, lead a free-living, predaceous life, devouring any living animal that can be attacked and injured, as well as feeding upon animals recently killed. Consequently, their foods can be drawn from the teeming life of the litter and mold of the forest floor stratum.

The second important habitat, the ant society, offers at least as many, if not more possibilities of obtaining the proper foods with the minimum danger. This is especially so if the species is tolerated by the host workers.

As suggested earlier, the species of *Batrisodes* are tolerated inmates of the ant society, where they have been investigated.

When a nest is opened in the field, the beetles and ants attempt to reach deeper galleries, or take cover under pieces of the nest without interfering with each other.

In the laboratory, many years of observation have confirmed the synoekete status of *globosus, frontalis* and *monstrosus.* When a host worker comes into contact with a beetle, the latter often crouches down or walks rapidly off. The ant usually does no more than pause and twirl her antennae. On rarer occasions, an ant has been seen to bite at the beetle. The latter easily slides out of the grasp of the ant's mandibles, and the ant does not continue the attack.

If *globosus* is confined in narrow quarters with several workers of *Formica ulkei* these repeated attacks may be observed; the same species of beetle taken with *Lasius aphidicola,* confined in the same way, is not as apt to be bitten. Nevertheless, even with *ulkei* the beetles appear able to escape death, and the differential response of the host is to be expected. In one case a *globosus* was placed with several *ulkei* workers in a small

petri dish without food. Over night the beetle was caught and dismembered.

The general bearing of such observations and experiments suggests that *Batrisodes* can penetrate the ant society, and live a relatively unmolested life in its spacious galleries, where food, and protection from enemies, other than rare attacks by the host, offer optimal conditions.

In ant nests these beetles feed on a variety of foods. The nests usually harbor numerous mites, many of which are ectoparasitic. A common acarid is the large, light brown gamasid *(Antennophorus wasmanni* Wheeler) that rides about on the workers of *Lasius aphidicola* (Park, 1932a). These and similar forms are natural foods of pselphids, whether in floor mold or specialized for life in the ant society.

Davey (1945) reports that pselaphids destroy mites in ant nests, and remove mites from the ant's integument, thus performing an indirect service to the ant society.

Such a service tends to balance the scales, since *Batrisodes globosus* and *frontalis,* at least, are known to feed upon ant larvae.

These tolerated beetles are to be expected to continue their natural carnivorism in the ant nest. *Batrisodes globosus* did not take sugar syrup provided in experimental nests (Park, 1929), and often was observed to walk through the solution, or become caught in it, without taking any with the mouth-parts.

On the other hand, *globosus* feeds on the larvae of *Lasius niger americanus* (Park, 1932b). Living host larvae, larvae crushed and fresh, and dead and discolored larvae, were experimentally offered to this species of. pselaphid. All were. attacked and eaten. The beetles did not show a tendency to eat every day. Occasionally a beetle would eat on two consecutive days. Generally they fed every other day. Duration of feeding varied from desultory biting to continuous eating for ten minutes. Since the dead and discolored ant larvae were also eaten, it is noteworthy to point out that scavengerism may also be of service in the ant society, and, with the destruction of mites, tend to offset the negative rôle of *globosus.*

Recently, unpublished data on *Batrisodes frontalis* have been analysed. This species was observed in experimental nests with its host, *Lasius aphidicola,* and an attempt was made to determine the amount of food consumed, and the time of eating.

The average amount of food consumed was one host larva per pselaphid per twenty-four hours, and the beetles generally ate the larvae at night, between 5:00 P.M. and midnight. The bearing of this will be noted later.

Donisthorpe (1927) observed the palaearctic *Batrisodes delaportei* carrying the immature larvae of *Acanthomyops brunneus* between their mandibles, and we may conclude that the feeding on ant larvae, dead or

alive, is a normal response for species that inhabit ant nests. Here again, much more information is needed, and at present it appears that the feeding habits of the species are not appreciably different, whether in forest mold or in the ant nest; and that the host's society is harmed by consumption of the brood, and benefited by the eating of nest mites as well as scavengerism.

Enemies. The only definite data on enemies of *Batrisodes* concerns the record of *hairstoni* in the stomach of the red-backed salamander, *Plethodon cinereus,* discussed previously. Since several *Aphaenogaster* workers, and a gamasid mite, were included in the stomach contents, the assumption is that the salamander was feeding upon an ant colony, and the beetle taken along with the other nest inhabitants.

On the other hand, this salamander is insectivorous (Jameson, 1944) , and is characteristic of rich forests, where it inhabits the floor mold. Therefore, the red-backed salamander in particular, and forest-dwelling salamanders, toads and frogs in general, are to be considered potential predators of *Batrisodes,* the species of which inhabit forest floor mold and ant nests.

Whereas this salamander datum serves to complete the food-chain between the food of *Batrisodes* and its enemies, it is but a single record and the entire problem needs further study.

Of particular interest would be an examination of the stomach contents of *Plethodon cinereus* and its allies for possible additional records of their feeding upon pselaphids.

Direct experimental confinement of these amphibians with individuals of *Batrisodes* should yield suggestive data, not only as to whether the pselaphids would be eaten, but the time of the day-night cycle any feeding occurred. The red-backed salamander is known to be predominantly nocturnal. The species is described as strictly nocturnal by Piersol (1910, p. 470). The salamanders pass the day beneath stones and log mold, and tend to become active in northeastern Ohio beech-maple forests by 8:45 P.M. (Park, Lockett and Myers, 1931, p. 718). In moist, closed Petri dishes this species of salamander demonstrated a strong preference for low light intensity during the daytime (Test, 1946) .

Apparently these data show a positive correlation between the time of activity of the predator and its prey.

Response to Moisture. Groups of *Batrisodes globosus* have been tested in Petri dishes with respect to substrate moisture and relative humidity (Park, 1929). In closed dishes with moist filter paper floors, with light and temperature relatively constant, the activity and length of life was contrasted with that of controls in which the filter paper floors were dry.

The beetles wander over the moist filter paper, but as the water gradually evaporates, they restrict their activities to the moister areas. Eventually, the pselaphids crowd together in a compact mass on the moist spot, and die there as it dries out.

This response, frequently repeated under controlled conditions, suggests that in its naturally moist habitats this species (and presumably the whole genus) tends to wander freely, and that it is restricted to such habitats by a positive response to a high relative humidity.

Response to Light. Both sexes of *globosus* were tested for their phototropism (Park, 1929). With temperature and relative humidity relatively constant, the beetles were exposed to light of 120 foot-candles and darkness. Under experimental conditions, they averaged sixty per cent photonegative.

This response, in combination with the positive response to high relative humidity, would tend to restrict the population to the moist, darkened recesses of the forest floor or the galleries of the ant nest.

Activity. Species *of Batrisodes* have a regular, unhurried walk amidst the hurry of the worker ants. Pselaphids in ant nests in general tend to move more slowly than their hosts. Since such species are either synoeketes or symphiles, and tolerated or actively attended by their hosts, there appears to be an indirect correlation between their rate of locomotion and their place in the ant society (Park, 1947). That is, actively tended symphiles (clavigerids) move more slowly than the tolerated synoeketes *(Batrisodes).*

For example, a common host, *Lasius aphidicola,* moves over a smooth surface at between 75 and 150 centimeters per minute, and *Batrisodes frontalis* and *B. schaumi* at between 40 and 125 centimeters per minute (Park, 1947). In another case, the larger *Formica ulkei* workers moved at between 150 to 200 centimeters per minute, and *Batrisodes globosus* moved at between 65 and 80 centimeters per minute (Park, 1929). The rate of travel was subject to variation depending upon the experimental conditions but the slower average speed of the beetles would tend to place a positive survival value in the nest upon agility and adjustments other than speed.

Batrisodes, in common with the great majority of pselaphids, tend to be nocturnal, or more properly crepuscular. Their greatest period of activity, dusk to midnight, coincides with the part of the twenty-four hour cycle that has both a high relative humidity and a low light intensity. These two conditions probably regulate and reenforce their activity pattern. *Batrisodes globosus* may be taken in flight at dusk, and the dusk flight of several species was known to LeConte (1850, p. 94).

Summing up, the species of *Batrisodes* occupy two chief habitats, namely, the floor mold of forests and the nests of ants. They are carnivorous, and exhibit active predatism and scavengerism. Their chief foods include mites, both in litter (Oribatidae, Hoplodermatidae) and ant nests (Gamasidae), earthworms, and the brood of ants. The species tend to be positive to high relative humidity and low light intensity. They tend to be crepuscular in activity, and may fly at dusk. These several adjustments and responses serve to more or less restrict the lations to their natural habitats.

THE WESTERN OUTLIERS OF EASTERN POPULATIONS

Brendel and Wickham (1890) separated the majority of the then-known species of *Batrisodes* into two portions, one composed of "Pacific coast species," and one of "Eastern species."

Since that time the literature has continued to emphasize this geographic separation (Casey, 1893, p. 469, 1908, p- 260; Bowman, 1934, p. 57). The author was similarly converted to this pleasantly simple situation.

The realities appear to be more complex.

Wickham (1898) reported taking *Batrisodes frontalis* in the nest of *Lasius claviger,* and *Batrisodes globosus* in the nest of *Camponotus herculeanus* at Colorado Springs, Colorado.

Both *globosus* and *frontalis,* are typical of the eastern fauna and the Wickham records should have warned us that certain species that were distributed through the deciduous forest biome had western outliers as well.

While studying a part of the Wickham collection, deposited at the Chicago Natural History Museum, these Colorado specimens were found and the identifications verified. Subsequently, a pair of *globosus,* collected in recent years at Boulder, Colorado, was sent to me for identification by the University of Colorado Museum. Finally, a specimen of *nigricans* was found, in the Frank J. Psota collection, from Denver, Colorado.

These several specimens are examined in Table II, page 118.

From this table certain interesting observations and inferences are possible. (1) All of the *frontalis* and *globosus* specimens were taken with ants. This is interesting in connection with the LeConte Hypothesis, discussed presently. (2) Where these ants are named, they are either identical with, or closely allied to, hosts that normally harbor these species of *Batrisodes* in the eastern range of the pselaphids. (3) Where altitudes are given, the records indicate that the pselaphids were taken

TABLE II

WESTERN OUTLIERS OF EASTERN SPECIES

Species of *Batrisodes*	Eastern range of species	Data on western specimens	Place of deposition
frontalis	Olmsted County, Minnesota southward through Johnson County, Iowa, Missouri and Douglas County, Kansas; eastward through Wisconsin and Manitoba on the north, and Hamilton County, Ohio on the south, into Pensylvania.	♂ Colorado Springs, El Paso County, Colorado. H. F. Wickham. June 15-30, 1896. 6000-7000 feet with *Lasius claviger*.	Chicago Natural History Museum
		♀ Buena Vista, Chaffee County, Colorado. H. F. Wickham. July 1-6, 1896. 7900-8000 feet.	Chicago Natural History Museum
globosus	On the north from Quebec, Vermont and Massachusetts west into Vilas County, Wisconsin; south through Johnson County Iowa, Douglas and Montgomery Counties, Kansas, Washington County, Arkansas to Texes and Natchitoches Parish, Louisiana; eastward into central Florida.	♂ Colorado Springs El Paso County, Colorado. H. F. Wickham. June 15-30, 1896. 6000-7000 feet with ants.	Chicago Natural History Museum
		♂, ♀ Boulder, Boulder County, Colorado. M. T. James. May 13, 1933. with ants.	University of Colorado Museum
nigricans	Long Island, New York south through Ocean County, New Jersey, into South Carolina.	♂ Denver, Denver County, Colorado. F. J. Psota collection.	Chicago Natural History Museum

not higher than the aspen-birch stratum, and probably in a richer deciduous forest stratum with a developed floor mold.

Several possible explanations are available to account for the Colorado island of eastern *Batrisodes,* but none of them are firmly established. Too little field work is the major handicap

(1) That *frontalis* and *globosus* formerly occupied a continuous range from the Atlantic seaboard westward, through the deciduous forest biome and grass land biome, up the eastern slope of the Rocky Mountains to at least 8000 feet, and have since become restricted to the deciduous forest. I do not give this view serious consideration as the known ecology of these species does not suggest such tolerance to differential amounts of moisture, and there is no parallel zoogeographic material in other animals, save those that have become adjusted to the society of man *per se.*

(2) That *frontalis* and *globosus,* both facultative. synoeketes, have moved into Colorado, protected by the dark, moist, food-rich *milieu* of .a series of ecologically equivalent host ants:

(a) westward through Kansas and Nebraska (but if this is so where are the records?), or

(b) north and northwest, through central Manitoba, following timbered fringes through Saskatchewan and Alberta, then southeastward along the Rocky Mountains, at altitudes where their forest floor adjustments could be utilized (Pl. IX) .

This last view presupposes that future collecting should yield records along the line of dispersal. So far there are none known to the author. Despite the seemingly long way around, this last possibility has some support in parallel zoogeography. For example, Grubman (1941) has shown that the green snake, *Ophheodrys vernalis,* has a somewhat similar, although shorter, arcuate dispersal pattern.

Whatever the explanation, the interested reader may well imagine with what attention the Colorado material was examined for subspecific criteria. There were very slight differences in the *fronitalis* and *globosus* specimens, but both have large eastern populations, the external anatomy of which is subject to considerable variation, in both sexes. Without more specimens, and with no data on intergradation, the question of subspeciation was shelved for future consideration.

The single *nigricans* record is startling. This species is not common in collections, and appears to have a limited distribution along the Atlantic seaboard. If the locality record from Colorado is authentic, the distribution pattern is more difficult to understand than for *frontalis* and *globosus.*

Summing up, there appear to be at least four *Batrisodes* faunas in North America. (1) The truly western or Pacific coastal fauna of eleven species, from British Columbia southward through California and eastward into Nevada and Idaho. (2) A Colorado fauna of outliers of eastern species. (3) A large, complex fauna of forty-one species that occupies the deciduous forests in large part, and the transitional coniferous-deciduous forests on the north and the grassland-forest transition on the west. (4) An Alabama cavernicolous fauna.

A possible integration is suggested in the following section.

BEARING OF THE LECONTE HYPOTHESIS ON THE ZOOGEOGRAPHY OF THE GENUS, AND GENERAL OBSERVATIONS ON PSELAPHIDAE

Determination of center of origin and paths of dispersal are of fundamental importance in a study of the central biological problem of evolution. In groups where there is little or no palaeontological data, as in Pselaphidae, the conclusions are often unsatisfactory. Nevertheless, the present distribution of species, and their ecology throws some light on the situation in *Batrisodes.*

In his early monograph on the pselaphids of the United States, John L. LeConte (1850, p. 94) stated:

"In the Northern States an individual of this genus [*Batrisodes*] is scarcely ever seen apart from a colony of ants, but in the South, they are quite frequently found under the bark of trees."

This important ecological generalization has remained insufficiently recognized for nearly a century. It is here proposed that it be termed the LeConte Hypothesis.

To the best of my knowledge, this hypothesis is sound. Species of *Batrisodes* may occur in ant nests in southern habitats, and others may occur apart from ants in northern habitats, but the frequency of occurrence in ant nests increases steadily from southern to northern localities.

Turning from the Nearctic to the Palaearctic and Oriental Regions, we have a similar situation. The French expert, Achillé Raffray (1908, p. 158) states with respect to *Batrisodes:*

"Parmi les espèces d'Europe, plusiers sont myrméophiIes; en IndoMalaisie les *Batrisodes* habitent surtoutt dans les détritus végétaux et les feuilles mortes."

These similar views suggest that the LeConte Hypothesis has global application, and this being the case there must be some fundamental reason for its applicability.

The answer is found in a study of the tolerances of the populations to the critical variation of natural influences in their environments. Where

species have been studied, they have been found to feed upon the myriads of small, chiefly herbivorous mites and insects that infest the floor mold of forests. Consequently they are indirectly restricted to vegetable debris. They are also relatively photonegative, and positive for a relatively high amount of moisture. All of these things combine to restrict them to forest floors, or their equivalents.

The complex society of ants is an equivalent in general terms, the relatively humid, dark nest chambers and galleries being not too dissimilar from log and leaf mold. The penetration of such habitats as ant nests would require adjustment to the host, and the substitution of gamasoid mites and ant larvae for oribatoid mites and other mold-inhabiting animals. The genus has made this adjustment. The species inhabiting ant nests are synoeketes, and are known to feed on gamasoid mites and the ant brood where they have been studied.

Consequently, it is probable that the species of *Batrisodes* tend to invade the societies of ants more frequently in the North Temperate areas, and so gain an amelioration of their immediate environment that would not be possible if they were free-living inhabitants of floor mold. Probably many factors are involved, such as the lower mean temperature, more prolonged winter, with its physiologically inaccessible moisture, smaller amount of food per unit area, and the less uniform length of day and night.

If this explanation of the LeConte Hypothesis is tenable, then its importance can be realized on a broader zoogeographic basis for what has been said in favor of southern portions of the North Temperate and subtropical areas is even more obvious for the Tropical Zone.

We agree with Raffray (1908, p. 158) that this is a genus having its center of dispersal in southeastern Asia. Other things being more or less equal, areas of greatest taxonomic density would seem to be those of historical importance. The following table demonstrates the dispersal pattern.

TABLE III

DISTRIBUTION OF BATRISODES BY REGIONS

Region	Number of species	Percentage of species
Palaearctic	41	18.7
Nearctic	52	24.0
Ethiopian	4	1.8
NeotropicaI	0	0.0
Oriental	83	38.2
Australian	34	16.0
Totals	214	98.7

From this table it will be noted that about four-tenths of the known species of *Batrisodes* are from the relatively poorly known Oriental Region; that from this center the relatively well known peripheral areas have much smaller regional faunas. No species is known to inhabit two regions. This distribution is suggested in Plate X.

Such a hypothetical Oriental center is not only in accord with the area of highest taxonomic density but is justified by the abundance of species in this area that do not live with ants.

In the plate of *Batrisodes* distribution there are several points of interest. Of notable importance is the relatively high peripheral density of southeastern North America paralleling the high density of southeastern Asia. This situation is also found in several other groups of organisms.

One hypothetical dispersal route is through the East Indies into New Guinea and Australia. It is interesting in this regard to note that in Australia it is the eastern forested areas that have a high taxonomic density. In general the arid areas of the world, where forests, vegetable mold and presumably mold mites are absent or poorly developed, are areas with few or no species of *Batrisodes.*

Two regions, the Neotropical and the Ethiopian, are impoverished. The Neotropical Region lacks any species *of Batrisodes.* The absence of the genus from this area has been discussed (Raffray, 1923, 1924; Park, 1942, p. 248). There are several explanations available. (1) The absence of the genus may be a consequence of the historical factor; that is, the genus has not had sufficient time to spread southward from the Nearctic. (2) This dispersal may be blocked at the present time by the relatively great aridity of southwestern United States and northern Mexico. (3) Southward dispersal may be retarded or blocked by biotic competition of the large, endemic, and presumably long-established and well-adjusted neotropical batrisine fauna. [11] (4) The genus may have entered the neotropical forests in the past and have evolved as the endemic genus *Iteticus.* The morphological differences between *Batrisodes* and

[11] A complementary situation is found in the genus *Arthmius* and its close allies, *Syrbatus* and *Syrmocerus. Arthmius* and *Syrmocerus* are restricted to the Western Hemisphere; *Syrbatus* has three species in Africa. With the exception of these three species, these genera are overwhelmingly neotropical. *Syrbatus* has 30 neotropical species and *Syrmocerus* has 5 neotropical species but neither genus is known from the Nearctic. *Arthmius* has 99 neotropical and 5 nearctic species. Consequently these 134 arthmioid species appear to have arisen in the Neotropical Region and to have penetrated the Nearctic slowly and with difficulty. The other neotropical batrisine genera are also endemic, with the exception of one doubtful locality citation from Louisiana (Park, 1942, p. 214-259).

Iteticus are not too great to preclude such an assumption. Again, the lack of reliable palaeontological material and inadequate data on larval stages hamper speculation on the past history of pselaphids.

The Ethiopian Region has four species of the genus. This paucity may be interpreted as the result of the historical factor, but such an explanation is not too probable on general grounds. The chief difficulty to such a view is the large ignorance concerning pselaphids of Africa.

It is interesting to contrast the distribution of *Batrisodes* with the distribution of pselaphids as a whole. General data are assembled in Tables IV and V. [12]

Of the twenty tribes listed (Table IV), seven are either endemic or restricted almost wholly to one region. Of these seven restricted tribes, one (Schistodactylini) is Australian and four (Jubinini, Metopiini, Arhytodini, Attapseniini) are Neotropical. All seven are very small with the exception of Jubinini which is relatively of very modest size. The large tribes (Euplectini, Brachyglutini, Batrisini, Tychini, Tyrini) on the other hand are distributed through all six major zoogeographic regions. This suggests that the larger tribes are more ancient and have had more time to spread whereas the seven endemic or restricted tribes are more recent and have evolved from more ancient stock. In this connection it is of interest to note that two of the three peripheral portions of the land mass, e.g. Australian and Neotropical, contain five out of seven restricted tribes. Hence the terminal faunas, as we know them, tend to be more endemic than those of more central areas. Comparisons are made (Table V) that substantiate this point. This analysis shows that (1) there is a large and general similarity between the terminal faunas as contrasted with their nearest areas, and (2) that the pselaphid fauna of the Neotropical Region is much more endemic than that of the Australian. Future collecting should serve to strengthen rather than weaken these conclusions.

We have insufficient data as yet to map specific routes of dispersal or discuss special centers of evolution but several lines of evidence suggest a tentative and speculative center of dispersal in the Oriental Region (Pl. XI). The overwhelming numbers of recent species are restricted to tropical and subtropical areas. General food and habitat requirements of the family suggest a relatively warm, relatively well-forested area. The LeConte Hypothesis suggests such an area. Eleven out of twenty tribes, including all of the large ones, are present in the Oriental Region. This region is placed strategically with reference to dispersal over the East Indies into the Australian Region, northeastward over the Behring "bridge" into the Nearctic-Neotropical, northwestward into the Palaearctic and westward into the Ethiopian Region.

[12] Table V should have included an analysis of the relationship between the Palaearctic Region and the third terminal fauna, that of the Ethiopian Region. This is not feasible at present since so little is known relatively concerning the African fauna. It is the poorest known region with respect to pselaphids.

TABLE IV

SPECIES, SUBSPECIES, AND VARIETIES OF PSELAPHIDAE BY TRIBES AND ZOOGEOGRAPHIC REGIONS

	Tribes[13]	Palaearctic	Ethiopian	Oriental	Australian	Nearctic	Neotropical	Antarctic	Tribe Totals
1.	Faronini	16	3	0	151	10	4	0	184
2.	Pyxidicerini	0	14	30	3	0	6	0	53
3.	Jubinini	0	0	0	0	1	77	0	78
4.	Mirini	2	0	0	0	0	0	0	2
5.	Euplectini[14]	178	84	54	226	131	128	1[15]	802
6.	Brachyglutini	118	47	121	303	113	299	0	1001
7.	Metopiini	0	0	0	0	0	22	0	22
8.	Batrisini	117	47	233	63	59	190	0	709
9.	Tychini	355	42	23	30	22	33	0	505
10.	Goniacerini	0	9	0	0	0	10	0	19
11.	Cyathigerini	0	0	37	6	0	0	0	43
12.	Pselaphini	55	9	35	65	5	9	0	178
13.	Holozodini	0	1	0	0	1	1	0	3
14.	Hybocephalini	1	3	25	1	0	3	0	33
15.	Ctenistini	55	36	19	27	19	12	0	168
16.	Schistodactylini	0	0	0	5	0	0	0	5
17.	Tyrini	15	46	100	117	14	136	0	428
18.	Arhytodini	0	0	0	0	0	11	0	11
19.	Attapseniini	0	0	0	0	0	2	0	2
20.	Clavigerini	40	56	14	61	9	22	0	202
	Region Totals	952	397	691	1058	384	965	1	4448

[13] Not including two tribes: the Dimerini, formerly placed in Pselaphidae, but probably belongs in Staphylinidae; Mayetini, formerly placed in Staphylinidae, but belongs in Pselaphidae.

[14] Euplectini *sensu latiore*, including Euplectini and Trichonychini of authors.

[15] *Pseudeuplectus antarcticus* Enderlein, from Crozet Island, in the Indian Ocean, between Cape of Good Hope and Australia, at approximately 50 degrees East Longitude and 50 degrees South Latitude.

TABLE V

COMPARISONS OF TERMINAL. PSELAPHID FAUNAS

Australian-Oriental Comparison

	Oriental		Australian	
Total genera	142	100%	124	100%
Endemic genera	91	64%	90	73%
Genera common to both the Oriental and the Australian Regions	31	21%	31	25%
Non-endemic genera not found in the adjacent region	20	14%	3	*2%*
Total species	691		1058	
Endemic species	689		1056	
Species common to both the Oriental and the Australian Regions	2		2	

Neotropical-Nearctic Comparison

	Nearctic		Neotropical	
Total genera	65	100%	147	100%
Endemic genera	32	49%	126	85%
Genera common to both the Neotropical and the Nearctic Regions	21	32%	21	15%
Non-endemic genera not found in the adjacent region	12	19%	0	0%
Total species	384		965	
Endemic species	384		965	
Species common to both the Neotropical and the Nearctic Regions	0		0	

This plate does not suggest a single dispersal. Probably there have been many dispersals of separate components over long periods of time, as well as numerous secondary centers of evolution and dispersal (Raffray, 1923, 1924). At present at least four areas are known to have high taxonomic densities with reference to adjacent territory; viz., Australian Region, Neotropical Region, southern European-Balkan, and Madagascar

Certainly four influences have had an important directional effect: (1) suitable past tropical and temperate climates; (2) the presence of vegetable mold, and indirectly of forests; (3) the adjustment to the complex societies of ants; (4) suitable intercontinental connections. The operation of these influences suggests a long period of evolution but lack of adequate palaeontological data renders any more exact assumption speculative. In view of the large and highly endemic pselaphid faunas of the Australian and Neotropical Regions, the initial outlines of the present, dispersal pattern must have been complete not later than early Tertiary, and possibly much earlier. Prior to this period a long evolution from staphylinoid ancestors (Park, 1942) must have occurred.

ABSTRACT

The external anatomy of *Batrisodes* is discussed and illustrated with special emphasis upon the taxonomy of the Nearctic fauna.

Keys are given for males and females of North American species distributed eastward of the Rocky Mountains. Each of these species populations is then diagnosed and their known distribution described.

Three additional synonyms are reported. These are *curvatus* Sanderson, a synonym of *confinis* (LeConte); *harringtoni* Casey, a synonym of *scabriceps* (LeConte); *triarngulifer* (Brendel) a synonym of *nigricans* (LeConte).

Four new species of *Batrisodes* and one, new variety are described These are *sandersoni* (Illinois), *rossi* (Illinois), *hairstoni* (Indiana), *schaefferi* (North Carolina), and *striatus psotai* (Illinois).

Nearctic species of the genus are separated into nine groups.

The general ecology of *Batrisodes* is discussed, with emphasis upon habitat, integration into the societies of ants, food and. feeding behavior enemies, including the first record of a species of *Batrisodes* found in the stomach of a red-backed salamander, response to moisture, response to light intensity, activity, and the bearing of these ecological adjustments upon dispersal.

Three species typical of the deciduous forests of eastern North America *(globosus, frontalis,* and *nigricans)* also occupy nests of certain ants in eastern Colorado. These western outliers of eastern population are discussed in terms of possible dispersal.

LeConte (1850) noted that in the United States species of *Batrisodes* tended to occupy the nests of ants more frequently in the northern portions of their ranges than in the southern portions. This general view is elevated to the LeConte Hypothesis, and its bearing is discussed with respect to (a) the distribution of the genus *Batrisodes,* and to (b) the general distribution of Pselaphidae. Important influences in past dispersals are given as (1) a past temperate to tropical climate, (2) presence of vegetable mold, and inferentially of forests and an abundance of food, such as free-living mold mites, (3) suitable intercontinental connections. The family is examined briefly in terms of tribes and of zoögeographic regions, and terminal faunas are contrasted with their nearest regions.

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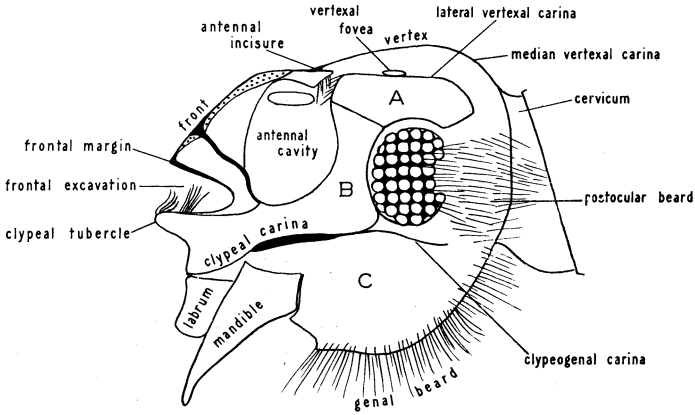
INDEX

PLATES I - XI

INDEX

PLATE I

1. *globosus,* male, left lateral view of head.
   A. supraocular field.
   B. anteocular field.
   C. subocular field.
2. *foveicornis,* male, left lateral view of head.
3. *bistriatus,* male, left lateral view of head.


vertexal
lateral vertexal carina
antennal incisure
fovea
vertex
median vertexal carina
A
cervicum
front
antennal cavity
frontal margin
frontal excavation
B
postocular beard
clypeal tubercle
clypeal carina
C
labrum
mandible
clypeogenal carina
genal beard

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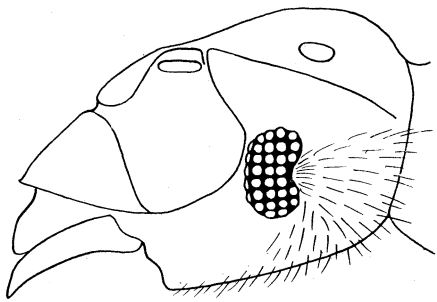

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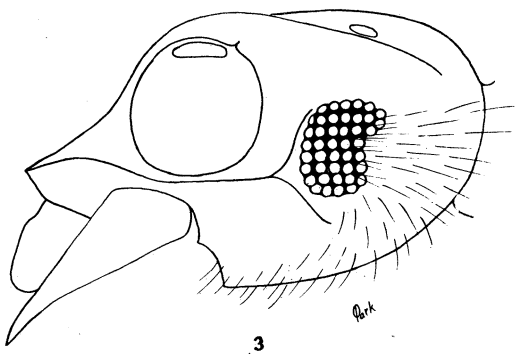
Park

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PLATE II

1. uncicornis, male, antennal segments IX, X and XI.
2. riparius, male, antennal segments IX, X and XI.
3. cavicornis, male, antennal segments X and XI.
4. globosus, male, antennal segments IX, X and XI.
5. foveicornis, male, antennal segments X and XI.
6. foveicornis, male, antennal segment XI from lateral view.
7. ionae, male, antennal segment VII.
8. schaumi, male, antennal segment VII.
9. antennatus, male, antennal segments IX, X, XI.
10. denticollis, male, antennal segments I, II, III and IV.
11. nigricans, male, antennal segments I, II, III and IV.
12. schmitti, male, antennal segments I and II.
13. scabriceps, male, antennal segments X and XI.

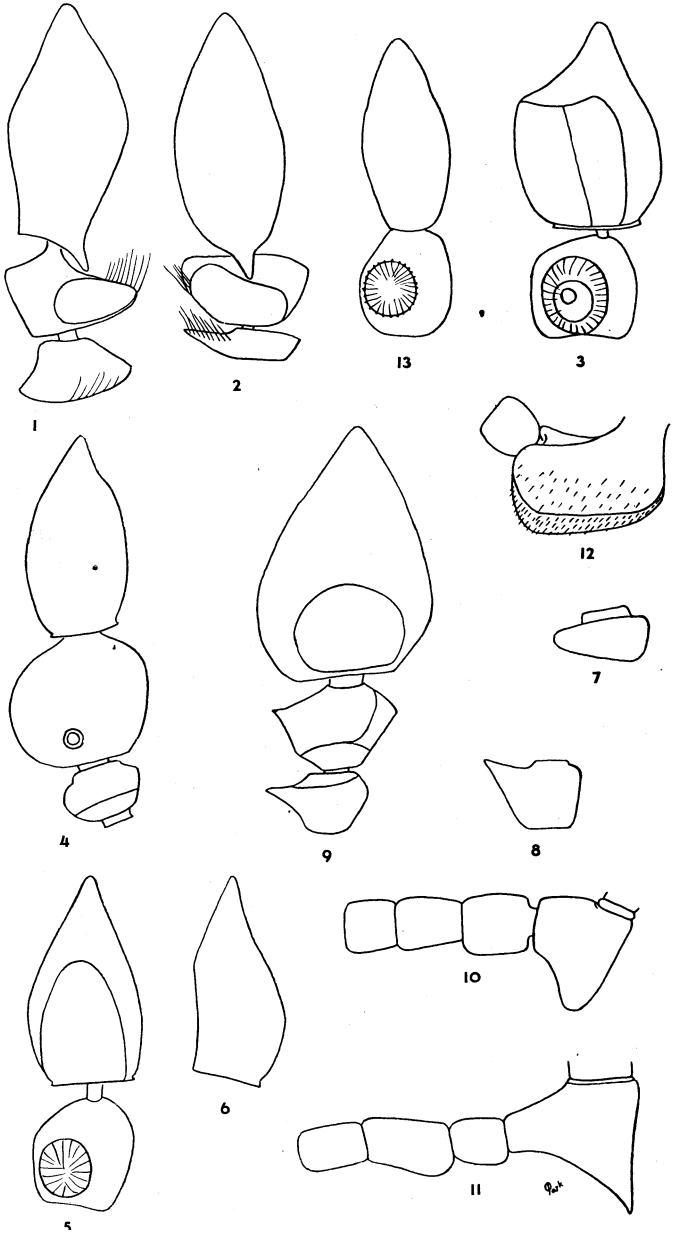
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PLATE III

1. *foveícornis,* male, apex of metathoracic tibia and tarsus.
2. *globosus*, male, apex of metathoracic tibia and tarsus.
3. *monstrosus*, male, apex of metathoracic tibia and tarsus.
4. *armiger*, male, apex of metathoracic tibia and tarsus.
5. *globosus*, male, apex of mesothoracic tibia and normal type of tarsus.
6. *cavicornis*, male, apex of mesothoracic tibia and abnormal type of tarsus.
7. *monstrosus*, male, prothoracic tibia.
8. *ionae*, male, mesothoracic femur.
9. *punctifrons*, male, prothoracic tarsal claws.
10. *furcatus*, male, prothoracic tarsal claws.
11. *frontalis*, male, prothoracic tarsal claws.
12. *punctifrons*, male, apex of mesothoracic tibia and abnormal type of tarsus.

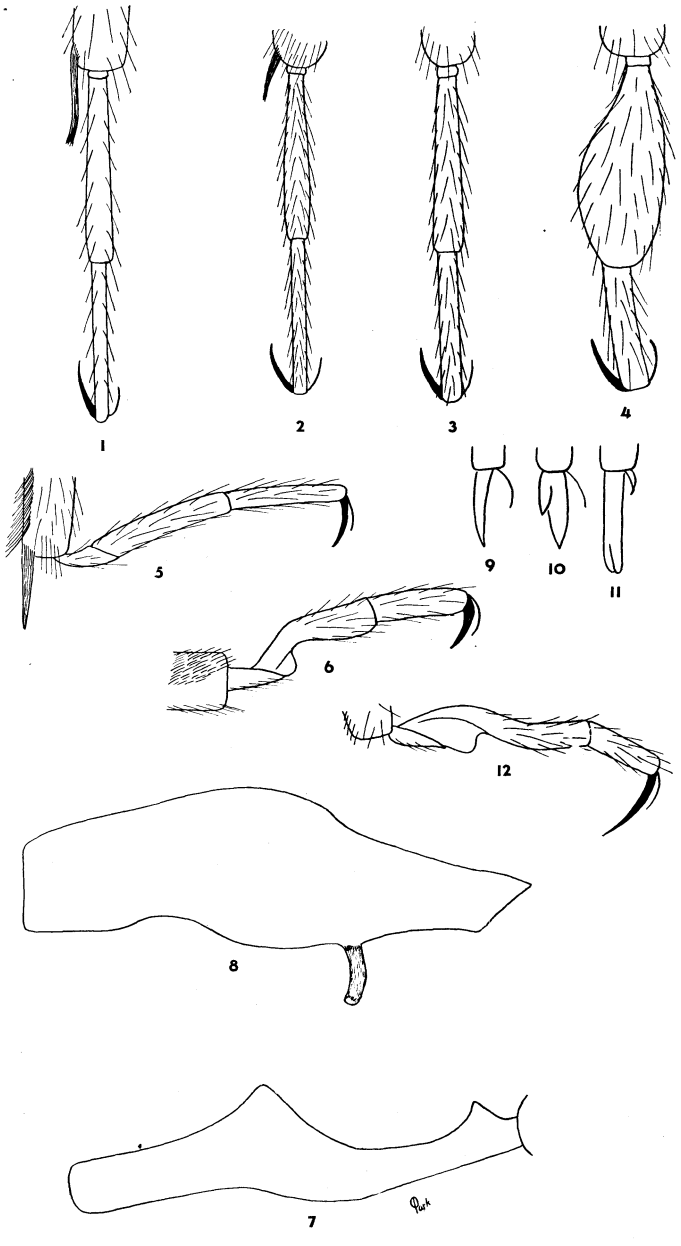
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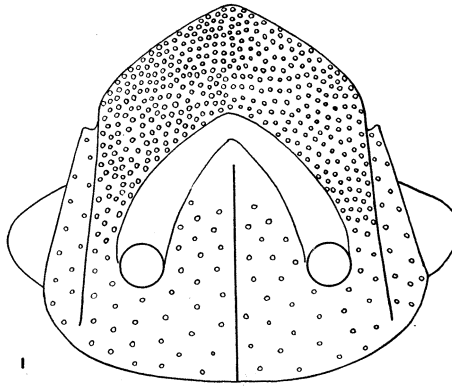
PLATE IV

1. globosus, male, dorsal view of head.
2. furcatus, male, dorsal view of head.
3. spretus, male, dorsal view of head.



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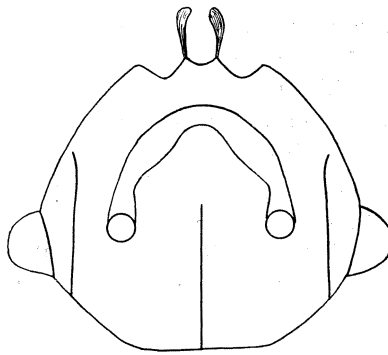

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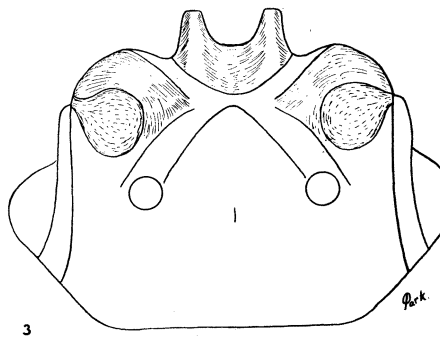

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PLATE V

1. lineaticollis and *bistriatus,* males, fifth sternite.

2. cartwrighti, male, fifth sternite.

3. fossicauda, male, fifth sternite.

4. cartwrighti, male, antennal segments X and XI.

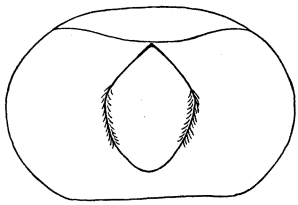
5. confinis, male, base of left elytron.

6. confinis, male, apex of mesothoracic tibia and tarsus.

7. punctifrons, male, dorsal view of head.

8. punctifrons, male, setae of frontal declivity, greatly magnified.

9. appalachianus, male, setae of frontal declivity, greatly magnified.



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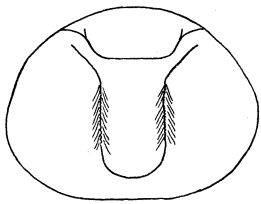

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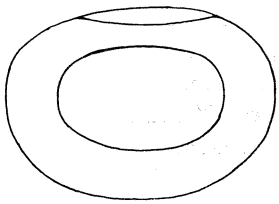

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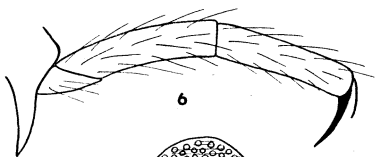

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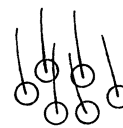

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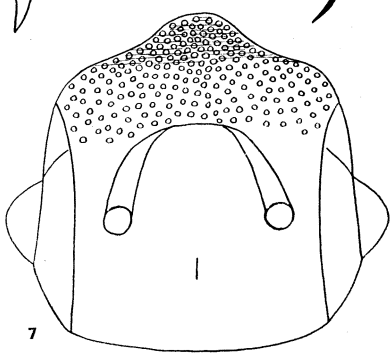

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PLATE VI

1. *sinuatifrons,* male, antenna1 segments X and XI.
2. *rossi,* male, antennal segments X and XI.
3. *sandersoni,* female, left lateral pronotal margin.
4. *cavicrus,* female, left lateral pronotal margin.
5. *hairstoni,* male, antennal segments X and XI.
6. *schaeferi,* male, mesothoracic tarsus.
7. *spretus,* male, antenna1 segments X and XI.
8. *scabriceps,* male, dorsal view of head.

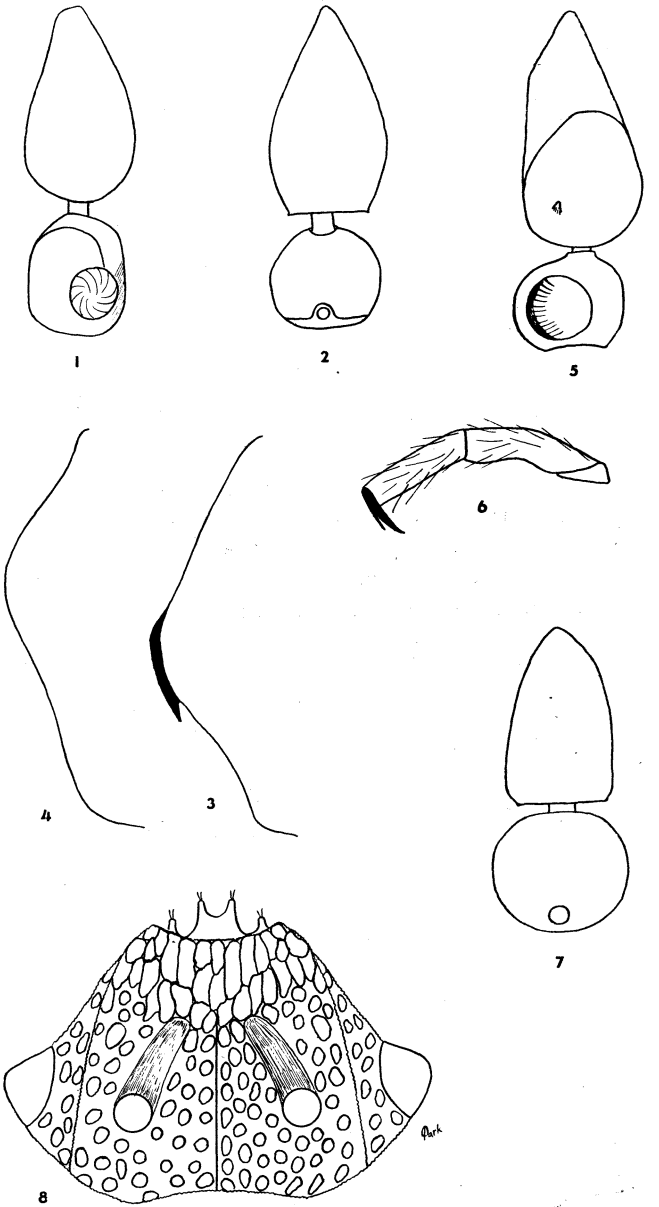
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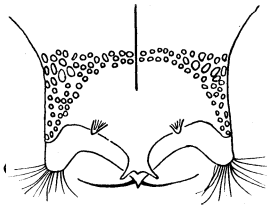
PLATE VII

1. *temporalis,* male, antennal segments X and XI, ventral face.
2. *temporalis,* male, frontal declivity, seen from above.
3. *svabtiveps,* male, frontal declivity, seen from above.
4. *temporalis,* aedeagus, 0.294 mm. long x 0.119 mm. wide.
5. *nigricans,* male, mesial view of antennal segments I, II, III, drawn from type (MCZ 6171).
6. *lineaticollis,* male, dorsal view of head.



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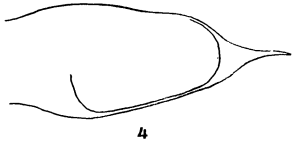

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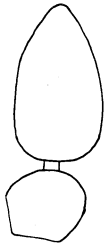

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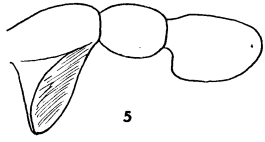

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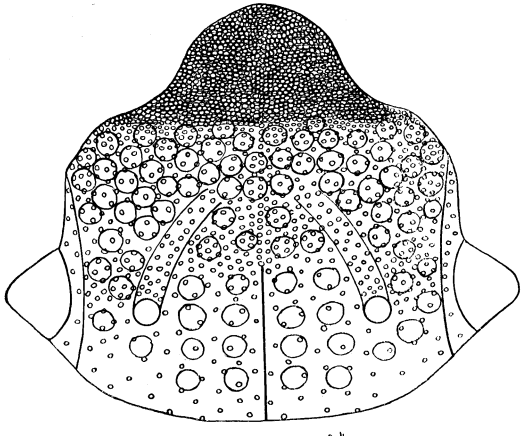

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PLATE VIII

Batrisodes globosus (LeConte) feeding on an oribatid mite.

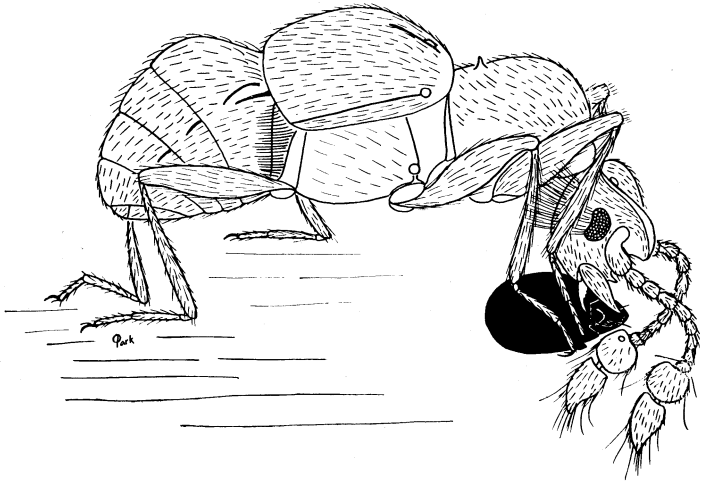

Park

PLATE IX

Distribution of *Batrisodes frontalis* (LeConte) and *Batrisodes globosus* (LeConte). Circles represent authentic locality records for *globosus* and triangles for *frontalis.* Arrows suggest possible former dispersal routes. See text for discussion.

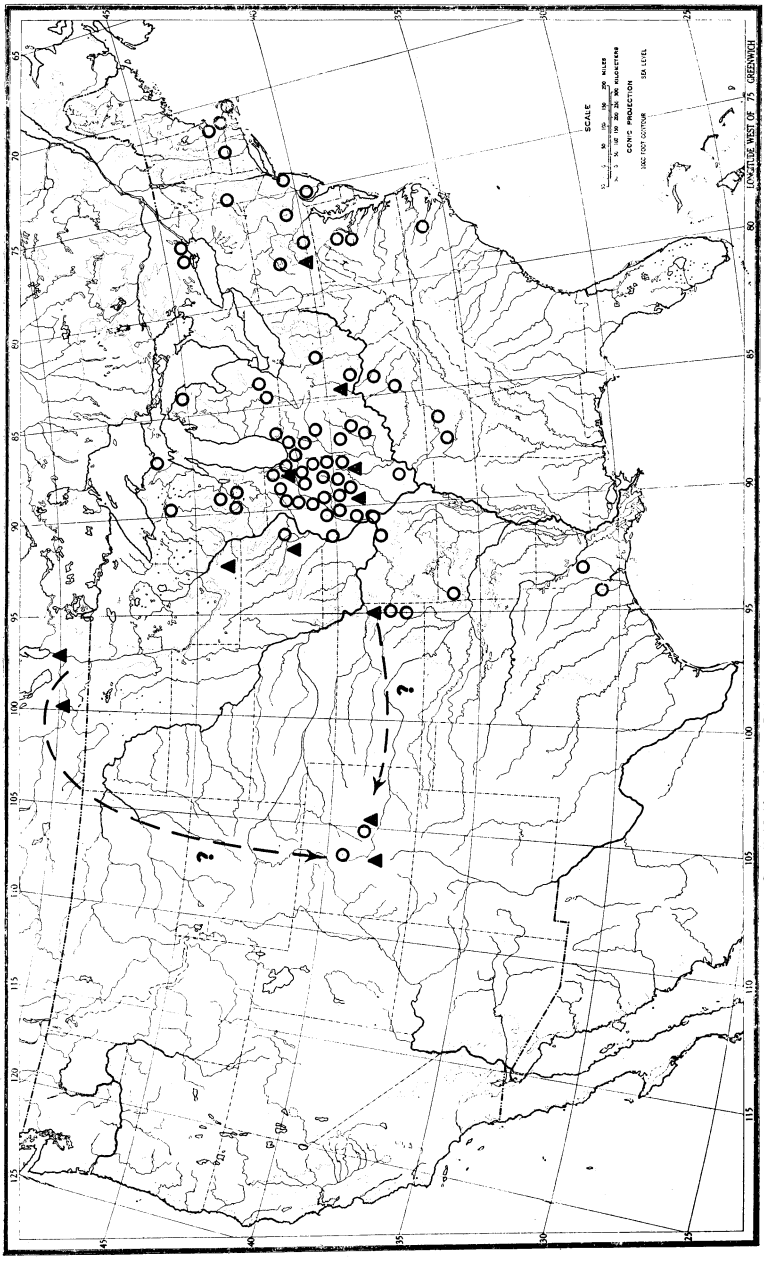

SCALE
GEOG. PROJECTION
Prepared by J. Paul Goode. Published by The University of Chicago Press, Chicago, Illinois. Copyright 1930 by The University of Chicago.

PLATE X

Distribution of the genus *Batrisodes*. Each black spot represents one species. Arrows suggest hypothetical and very generalized routes of possible dispersals.

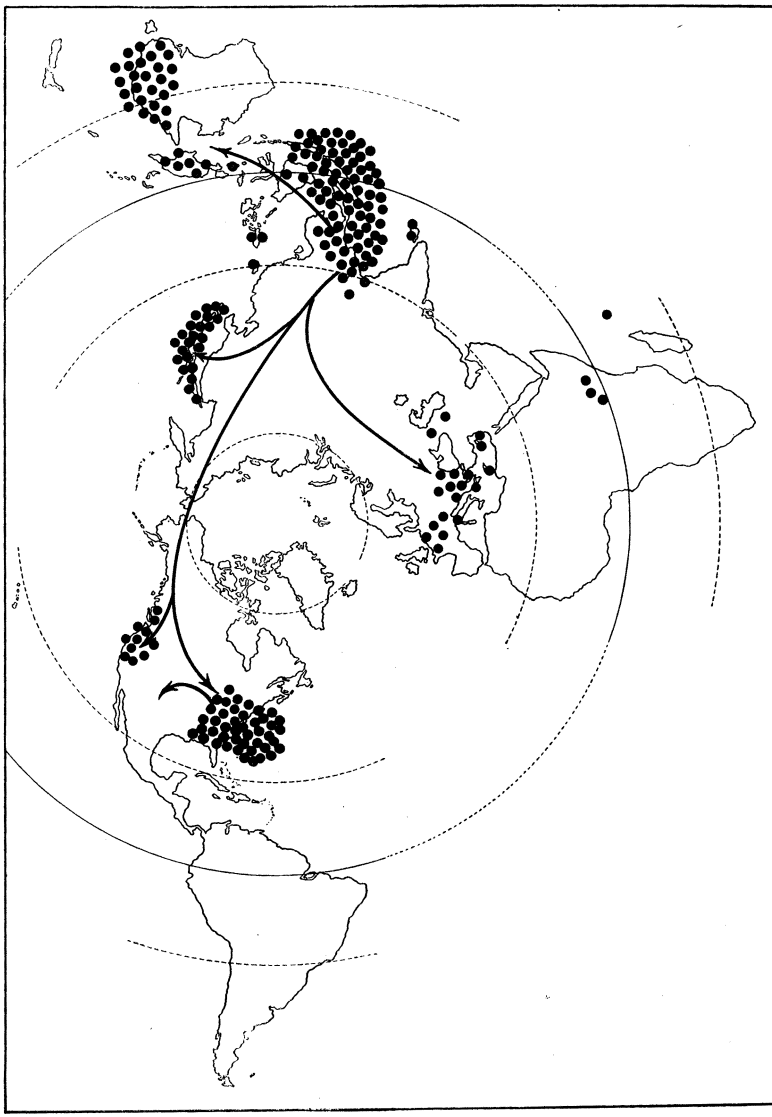
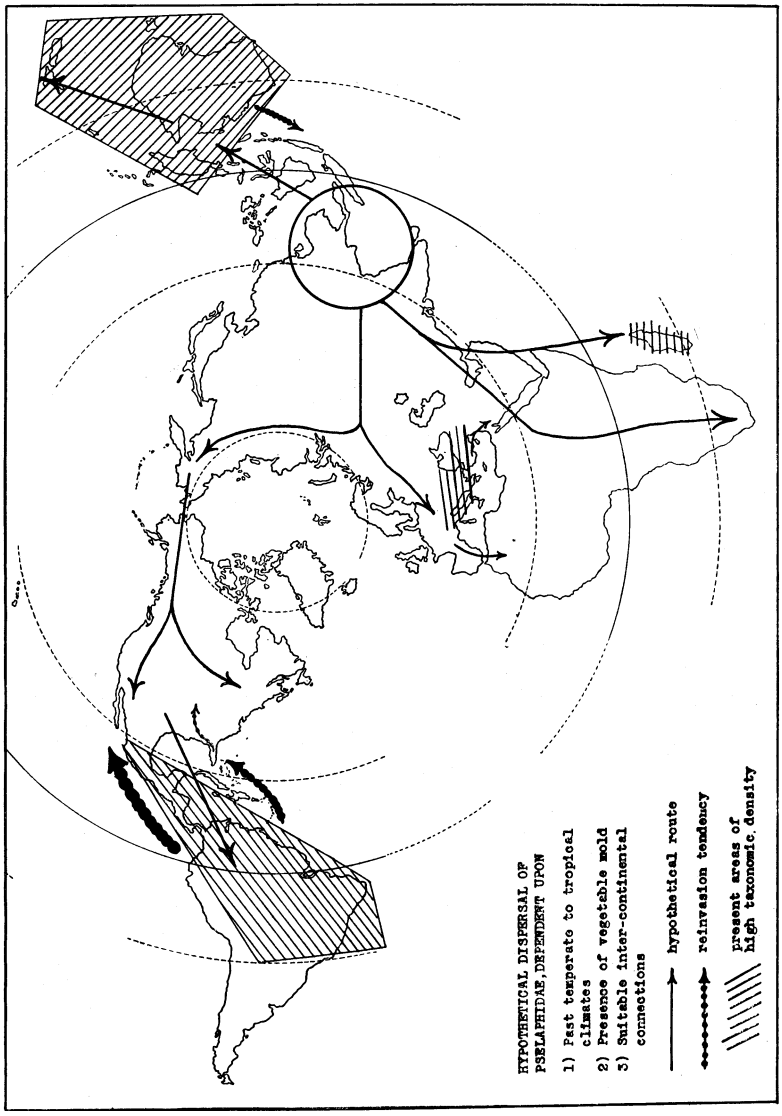


PLATE XI

Hypothetical dispersals of Pselaphidae.


HYPOTHETICAL DISPERSAL OF
PSELAPHIDAE, DEPENDENT UPON
1) Past temperate to tropical climates
2) Presence of vegetable mold
3) Suitable inter-continental connections
hypothetical route
reinvasion tendency
present areas of high taxonomic density